

LOWER CRETACEOUS FORAMINIFERA FROM MOUNT GOODENOUGH
NORTHWEST TERRITORIES, CANADA

ALEXANDER DAVIDSON, JR., B.A.

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THE UNIVERSITY OF ALBERTA

LOWER CRETACEOUS FORAMINIFERA FROM MOUNT GOODENOUGH

NORTHWEST TERRITORIES, CANADA

A THESIS

SUBMITTED TO THE FACULTY OF GRADUATE STUDIES

IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE

OF MASTER OF SCIENCE

DEPARTMENT OF GEOLOGY

by

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EDMONTON, ALBERTA

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UNIVERSITY OF ALBERTA

FACULTY OF GRADUATE STUDIES

The undersigned certify that they have read, and
recommend to the Faculty of Graduate Studies for acceptance, a
thesis entitled "Lower Cretaceous Foraminifera from Mount Good-
enough, Northwest Territories, Canada" submitted by Alexander
Davidson, Jr., B.A., in partial fulfilment of the requirements
for the degree of Master of Science.

ABSTRACT

Thirty calcareous and 26 arenaceous species of Foraminifera are described and illustrated from the Lower Cretaceous of Mount Good-enough, Northwest Territories, Canada.

Species described include: 5 species of Ammobaculites; 4 each of Dentalina and Saracenaria; 3 each of Glomospira and Haplophragmoides; 2 each of Discorbis, Lagena, Marginulina, Nodosaria, Proteonina, Robulus, Vaginulina and Verneuilina; and 1 each of ? Ammobaculoides, Ammodiscus, ? Bulimina, Dorothia, Eggerella, Eoguttulina, Epistomina, Eponides, Gaudryina, Globigerina, Globulina, Guttulina, Hyperammina, Marginulinopsis, Miliammina, Paleopolymorphina, Pseudoglandulina, Reophax, Saccammina, ? Textularia and Tritaxia.

Six zones are recognized on the basis of abundance and/or diagnostic species. In ascending order these are the Epistomina sp. 1590, Haplophragmoides sp. 1490 and Discorbis sp. 1470 zones of late Barremian age; the Tritaxia sp. 1300 zone of latest Barremian and earliest Aptian age; and the Globigerina sp. 1040 and Haplophragmoides sp. 510 zones of Aptian age. These foraminiferal assemblages are correlated with the microfossil zones of northwestern Germany.

The Upper Barremian fauna reflects changing conditions from an outer sublittoral to a littoral environment, while the Aptian fauna indicates an open sea environment changing to a fluctuating inner littoral and littoral environment.

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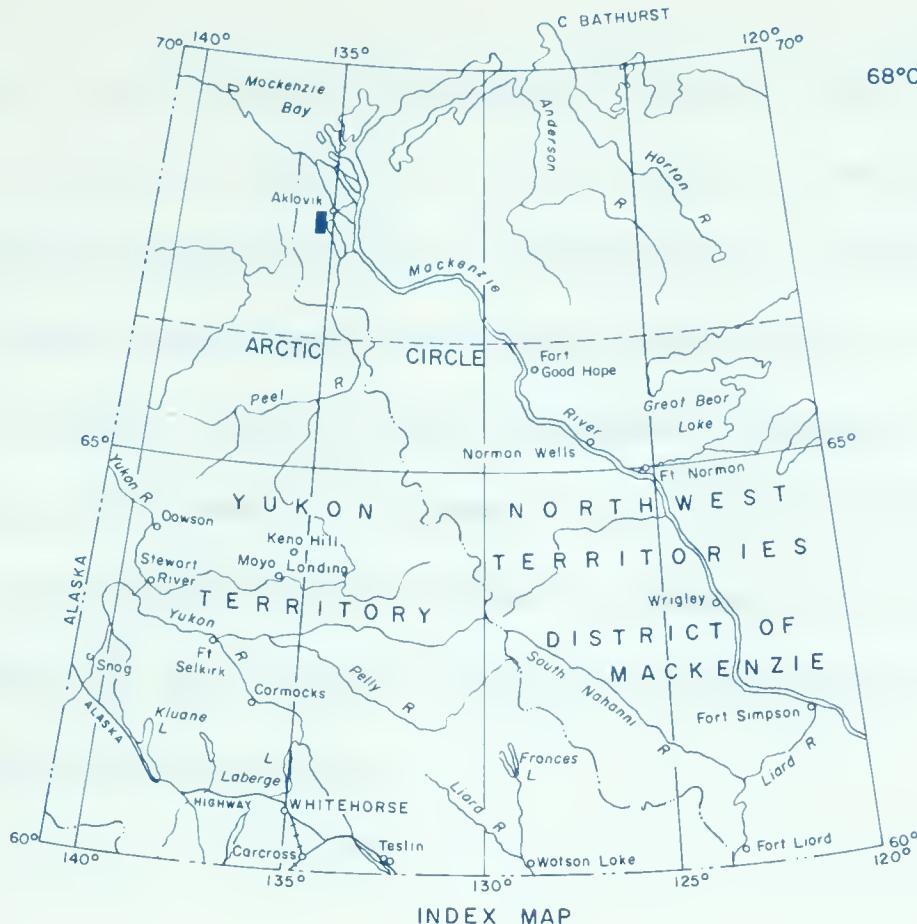
INTRODUCTION

This thesis is a microfaunal study of 47 samples collected from Mount Goodenough by Pan American Petroleum Corporation during the 1958 field season. Mount Goodenough is 30 miles southwest of Aklavik and 37 miles north of Fort McPherson (Fig. 1). Samples are from a stratigraphic interval of 1,620 feet and collected every ten feet where practical.

Mount Goodenough, locally referred to as Black Mountain, has a maximum elevation of 3,500 feet, and is located on the eastern side of the Aklavik Range. Samples for this thesis were collected along a prominent spur on the east slope of the mountain where there is relatively little talus and vegetation, and outcrops are generally good. Foot travel in the area is rather arduous because of the rugged nature of the tundra and limited number of trails.

The Mount Goodenough microfaunal assemblage contains both calcareous and arenaceous Foraminifera similar in appearance to those found by Hecht (1938) from the Upper Barremian and Aptian stages of northwestern Germany. Correlation between this area and Mount Goodenough is based on the occurrence of similar species of Ammodiscus, Dentalina, Epistomina, Eponides, Globigerina, Glomospira, Guttulina, Lagena, Marginulinopsis, Nodosaria, Robulus, Saracenaria, Tritaxia and Verneuilina.

Previous geological work in this area has been restricted to



CENOZOIC

5

QUATERNARY
Recent alluvial, talus, and bog deposits,
stratified sand, gravel and clay.

MESOZOIC

4

CRETACEOUS - LOWER CRETACEOUS
UPPERMOST BARREMIAN (?) AND/OR APTIAN
Upper Sandstone Division.

3

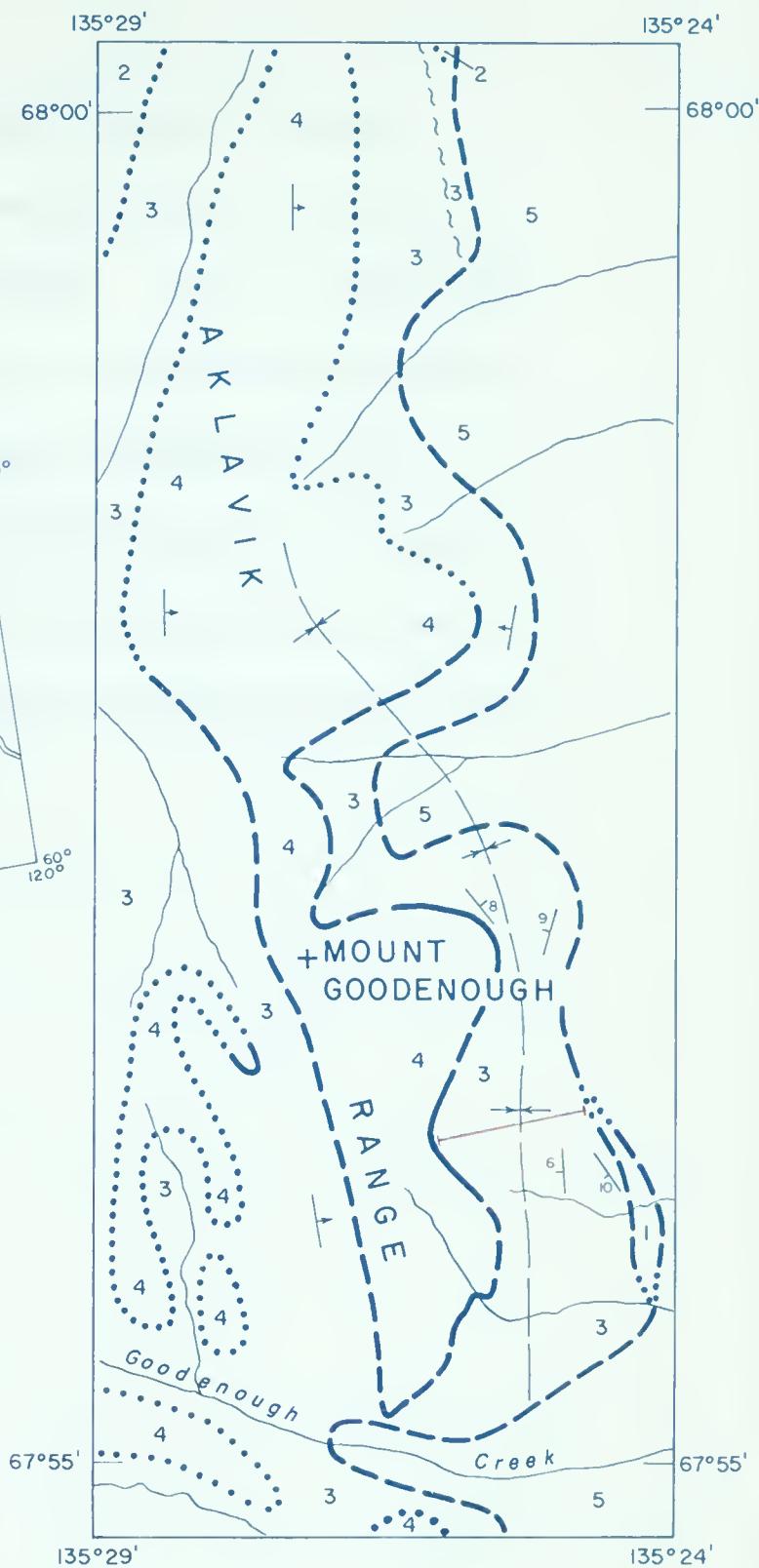
UPPER HAUTERIVIAN (?) AND BARREMIAN
Upper Shale - Siltstone Division

2

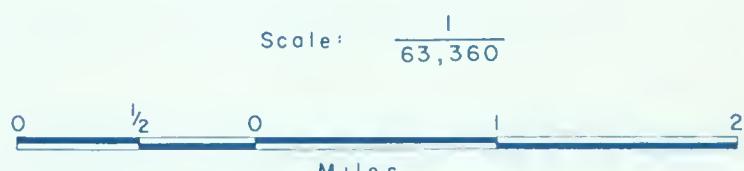
UPPER BERRIASIAN AND VALANGINIAN
Lower Sandstone Division.

1

JURASSIC AND CRETACEOUS
UPPER JURASSIC & LOWER CRETACEOUS
UPPER OXFORDIAN (?) TO UPPER BERRIASIAN
Lower Shale - Siltstone Division



- ... Geological boundary (defined, approximate, assumed)
- ↖ Inclined bedding
- ↗ Bedding (from air photographs or distant observation).
- ~~ Assumed fault
- ←→ Syncline (approximate, arrow indicates plunge).
- Approximate position of section described
- + Top of Mount Goodenough



After J. A. Jeletzky, Geological Survey
of Canada, Paper 58-2, 1958.

Figure 1.

a few brief visits by McConnell (1891, p. 116D), Camsell (1906, pp. 45c-46c), O'Neill (1924, pp. 16A-17A), Nauss (1944, pp. 13-14), Richards (1950, pp. 34-35), and Gabrielse (1957). Most of this work has been summarized by Hume and Link (1945, pp. 43-44) and Hume (1954, pp. 53, 75). All of these geologists correctly established the presence of Lower Cretaceous rocks on Mount Goodenough, but did not attempt to determine detailed stratigraphy or exact ages. Jeletzky (1958) was the first to publish a comprehensive description and correlation of these rocks.

STRATIGRAPHY AND PALEONTOLOGY

Mount Goodenough Megafaunal Divisions

Marine sediments of Late Jurassic and Early Cretaceous age are well exposed along the eastern and northern slopes of the Aklavik Range. These rocks have been tentatively subdivided by Jeletzky (1958, pp. 3-15) into four divisions: a lower shale-siltstone of Berriasian age, a lower sandstone of latest Berriasian and Valanginian age, an upper shale-siltstone of probable Barremian age, and an upper sandstone of latest Barremian and Aptian age (Fig. 2). Jeletzky included Upper Jurassic sediments in the lower portion of his lower shale-siltstone division, but these rocks are not exposed on Mount Goodenough. In ascending order the following is a brief summary of these divisions exposed close to the section sampled for this thesis.

The lower shale-siltstone division is a thinly bedded unit composed of greyish black shale and dark grey, sandy siltstone. Toward the top it becomes more sandy and contains clay-ironstone or silt-ironstone that weathers rusty red. Large and typical representatives of Aucella volgensis Lahusen and rare Polyptychites (Tollia) sp., cf. P. tolli Pavlow and Aucella ex gr. okensis Pavlow were collected by Jeletzky from Mount Goodenough and seem to indicate a Berriasian age for these rocks. Maximum thickness of this unit is about 30 feet.

The lower sandstone division will not be considered here because it is absent by erosion in the area sampled for this thesis.

CORRELATION OF LOWER CRETACEOUS FAUNIZONES AND FORMATIONS OF NORTHWESTERN CANADA AND GERMANY

SERIES	STAGE	STANDARD FAUNIZONES (After Muller and Schenck, 1941)	MICROFOSSIL ZONES OF MOUNT GOODENOUGH (This report)	MICROFOSSIL ZONES OF NORTHWEST GERMANY (After Hecht, 1938)	AKLAVIK RANGE N. W. T. (After Jeletzky, 1958)	PINE RIVER B. C. (After Warren and Stelck, 1958)
LOWER CRETACEOUS	ALBIAN	<i>Euhoplites laetus</i>	Unsampled			
		<i>Hoplites dentatus</i>		<i>Bathysiphon</i> sp D2	Unknown, probably present locally	Fort St. John group
		<i>Douvilleiceras mammillatum</i>				Sandstone and shale
		<i>Sonneratia trinitensis</i>		<i>Planulina</i> sp D5		3,800'
		<i>Leymeriella tardifurcata</i>		<i>Epistomina</i> sp D3 <i>Haplophragmoides</i> sp D8		
	APTIAN	<i>Acanthoplites jacobi</i>		<i>Eponides</i> sp D1		
		<i>Cheloniceras subnodosocostatum</i>	<i>Haplophragmaides</i> sp 510		? — ? Upper sandstone division	Continental Upper Bullhead group (Dunlevy & Gething)
		<i>Cheloniceras martini</i>		<i>Anamalina</i> sp D10		
		<i>Deshayesites deshayesi</i>				500' - 600'
		<i>Globigerina</i> sp 1040		<i>Globigerina</i> sp D9		
NEOCOMIAN	BARREMIAN	<i>Tritaxia</i> sp 1300		<i>Cristellaria</i> sp D112	Upper member 500' - 550'	
		<i>Discorbis</i> sp 1470		<i>Ammobaculites</i> sp D4		Sandstone, shale, conglomerate and coal seams
		<i>Haplophragmoides</i> sp 1490		<i>Discorbis</i> sp D1		4,500'
		<i>Epistomina</i> sp 1590		<i>Cristellaria</i> sp D79		
		?		<i>Cristellaria</i> sp D84		
	HAUTERIVIAN	<i>Costidiscus recticostatum</i>	Unsampled	<i>Epistomina</i> sp D7	Lower member 1,000' - 1,200'	
		<i>Heteroceras astierianum</i>		<i>Cristellaria</i> sp. D99		
		<i>Paracrioceras emericai</i>		<i>Lenticulina (Marginulinopsis) gracilissima</i> ?		
		<i>Pseudothurmannia angulicostata</i>		<i>Lenticulina</i> sp ?		
		<i>Subsaynella sayni</i>		<i>Triplasia pseudoroemeri</i> ?		
BERRIASIAN	VALANGINIAN	<i>Criaceras duvalii</i>	Unsampled	<i>Lenticulina (Vaginulinopsis) humilis humilis</i>	Overlap and erosional gap	
		<i>Acanthadiscus radiatus</i>		<i>Vaginulina striata</i>		
		<i>Kilianella rauaudiana</i>				
		<i>Palyptychites palyptychus</i>				
		<i>Platylenticeras heteropleurum</i>				
	TERTIARY	<i>Thurmannites baissieri</i>	Unzoned		White sandstone member 300'-	
		<i>Paradantaceras callistaoides</i>				

Figure 2.

Overlying the lower shale-siltstone division with a sharp, uneven, erosional contact is the upper shale-siltstone division. Jeletzky has subdivided this unit into two members. The lower one consists of dark grey to brown shale, dark to medium grey, sandy siltstone, and dull grey, fine-grained sandstone. Clay-ironstone concretions are very common, and much of the shale and siltstone is iron- and sulphur-stained. A six-inch bed of pebble-conglomerate occurs at the base of this unit, and is chiefly composed of black to grey chert in a matrix of buff, medium- to coarse-grained sandstone or grit. Maximum thickness of this member is 1,100 feet.

The upper member consists of resistant, grey to buff, fine-grained sandstone and dark grey, sandy siltstone with a few thin interbeds of soft, silty shale. Pyritic or marcasitic concretions are common, and worm-burrows are plentiful in some of the sandstone units. This member has a maximum thickness of 500 feet.

Megafossils are scarce and poorly preserved in the lower 800 feet of the lower member, but Oxyteuthis jasikowi (Lahusen), Oxyteuthis pugio var. rimata Stolley and Acroteuthis subquadratus (Roemer) do occur and seem to indicate an early Barremian or (?) late Hauterivian age for this interval. The upper part of the lower member and all the upper member of the upper shale-siltstone division carry a prolific faunal assemblage. The most diagnostic fossils occur in the top 200 feet of the upper member and include Crioceras (Hoplocrioceras) sp., cf. C. remondi (Gabb), Ancyloceras (Acrioceras) sp., aff. A. starrkingi Anderson, Ancyloceras (Ancyloceras) durrelli Anderson, and Crioceras

(Hoplocrioceras) n. sp. aff. C. laevisculum Koenen. On the basis of these ammonites Jeletzky (1958, p. 14) strongly favours a late Barremian age for this zone.

The upper shale-siltstone division becomes very sandy near the top and grades into the overlying upper sandstone division. This unit is a grey to buff, well sorted sandstone that is chiefly composed of fine- to medium-grained mica and quartz. Because of its resistant character, it forms prominent, vertical cliffs just below the rim of Mount Goodenough plateau. The complete absence of Barremian cephalopods and the occurrence of representatives of Aucellina in the lower part of this division suggest that it may be Aptian in age. Maximum thickness is 170 feet.

Microfaunal Zones

The section sampled for microfauna occurs within Jeletzky's upper shale-siltstone division (Fig. 2). Six foraminiferal zones have been arbitrarily established in this division and are designated by the name of the most abundant and/or diagnostic species present. All zones are included in the lower member except for the upper half of the Haplophragmoides sp. 510 zone which occurs in the upper member of this division. In ascending order the foraminiferal zones are as follows:

EPISTOMINA sp. 1590 ZONE - This zone of middle Barremian age spans a stratigraphic interval of 30 feet extending from 1,590 to 1,620 feet below the top of Mount Goodenough. Species diagnostic of and restricted to this faunal zone are Epistomina sp. 1590, Miliammina

sp. 1590, Nodosaria sp. 1590 and Saracenaria sp. 1590. Less diagnostic and rare are specimens of Marginulina sp. 1590 and Robulus sp. 1590 which also occur in the overlying Haplophragmoides sp. 1490 zone. Remaining Foraminifera are long-ranging and cannot be used for correlation purposes.

A complete foraminiferal faunal list follows:

Ammobaculites sp. 1040
? A. sp. 1470
Epistomina sp. 1590
Haplophragmoides sp. 1040
Marginulina sp. 1400
M. sp. 1590
Miliammina sp. 1590
Nodosaria sp. 1590
Reophax sp. 980
Robulus sp. 1490
R. sp. 1590
Saracenaria sp. 1590
Verneuilina sp. 1040
V. sp. 1190

HAPLOPHRAGMOIDES sp. 1490 ZONE - This zone of late Barremian age occupies a stratigraphic interval of 100 feet extending from 1,490 to 1,590 feet below the top of Mount Goodenough. Although fairly well preserved, many of the calcareous genera are represented by only one or two specimens. Arenaceous Foraminifera are abundant but rather poorly preserved and hard to identify.

Haplophragmoides sp. 1490 is diagnostic of this zone. Rare but restricted to it are Dentalina sp. 1490, D. sp. 1570, Glomospira sp. 1520, Hyperammina sp. 1510, Vaginulina sp. 1500, V. sp. 1490 and ? Bulimina sp. 1510. Less diagnostic and longer ranging species are Eggerella sp. 1570, Robulus sp. 1590, Lagena sp. 1420, Marginulina sp. 1590 and Nodosaria sp. 1490.

A complete list of Foraminifera in this zone follows:

Ammobaculites sp. 1040
? A. sp. 1470
? Bulimina sp. 1510
Dentalina sp. 1490
D. sp. 1570
Eggerella sp. 1570
Glomospira sp. 1520
Haplophragmoides sp. 1040
H. sp. 1490
Hyperammina sp. 1510
Lagena sp. 1420
Marginulina sp. 1400
M. sp. 1590
Nodosaria sp. 1490
Proteonina sp. 1400
Reophax sp. 980
Robulus sp. 1490
R. sp. 1590
Saracenaria sp. 1470
Vaginulina sp. 1490
V. sp. 1500
Verneuilina sp. 1040
V. sp. 1190

DISCORBIS sp. 1470 ZONE - This zone of late Barremian age spans a stratigraphic interval of 180 feet extending from 1,310 to 1,490 feet below the top of Mount Goodenough. Identification of this zone is rather difficult because most of the Foraminifera are long-ranging. Discorbis sp. 1470 is the most diagnostic species. Associated with it are rare specimens of Dentalina sp. 1420 and Saracenaria sp. 1400.

A complete faunal list follows:

Ammobaculites sp. 1040
? A. sp. 1470
Dentalina sp. 1470
Discorbis sp. 1470
Dorothia sp. 1300
Eggerella sp. 1570

Haplophragmoides sp. 1040
Lagena sp. 1420
Marginulina sp. 1400
Nodosaria sp. 1490
Proteonina sp. 1400
Reophax sp. 980
Robulus sp. 1490
Saracenaria sp. 1400
S. sp. 1470
Verneuilina sp. 1040
V. sp. 1190

TRITAXIA sp. 1300 ZONE - This zone occupies a stratigraphic interval of 250 feet extending from 1,060 to 1,310 feet below the top of Mount Goodenough. The lower half of latest Barremian age is persistently fossiliferous and can be easily recognized by its dwarfed assemblage of Foraminifera. The upper half of earliest Aptian age is relatively barren and carries only a few poorly preserved, arenaceous species.

Diagnostic Foraminifera in this zone are Tritaxia sp. 1300, Ammobaculites sp. 1300, ? Ammobaculoides sp. 1300 and Gaudryina sp. 1300. Rare but restricted to it are Ammodiscus sp. 1210, Glomospira sp. 1240, Pseudoglandulina sp. 1300 and Saccammina sp. 1300.

A complete foraminiferal faunal list follows:

Ammobaculites sp. 1040
A. sp. 1300
? A. sp. 1470
? Ammobaculoides sp. 1300
Ammodiscus sp. 1210
Discorbis sp. 1300
Dorothia sp. 1300
Gaudryina sp. 1300
Glomospira sp. 1230
G. sp. 1240
Haplophragmoides sp. 1040
Proteonina sp. 1300

Pseudoglandulina sp. 1300
Reophax sp. 980
Saccammina sp. 1300
Tritaxia sp. 1300
Verneuilina sp. 1040
V. sp. 1190

GLOBIGERINA sp. 1040 ZONE - This zone of early Aptian age is 20 feet thick and extends from 1,040 to 1,060 feet below the top of Mount Goodenough. The specimens are fairly well preserved but rare and long-ranging. Globigerina sp. 1040 is diagnostic of this zone.

A complete faunal list follows:

Ammobaculites sp. 1030
A. sp. 1040
? A. sp. 1470
Globigerina sp. 1040
Glomospira sp. 1230
Haplophragmoides sp. 1040
Proteonina sp. 1300
Reophax sp. 980
Verneuilina sp. 1040
V. sp. 1190

HAPLOPHRAGMOIDES sp. 510 ZONE - This zone of middle and late Aptian age occupies the upper 1,040 feet of the section on Mount Goodenough. Foraminifera are generally very scarce except for a few fossiliferous intervals occurring chiefly in the lower half of the zone. Large, coarsely arenaceous specimens are abundant and dominate the microfauna.

Haplophragmoides sp. 510 and Ammobaculites sp. 735 are diagnostic of this zone. Associated with these species are rare specimens of Dentalina sp. 510, Eoguttulina sp. 1030, Eponides sp. 220, Globulina

sp. 510, Guttulina sp. 510, Lagena sp. 735, Marginulinopsis sp. 1030,
Paleopolymorphina sp. 510 and ? Textularia sp. 510.

A complete foraminiferal faunal list follows:

Ammobaculites sp. 735
A. sp. 1030
A. sp. 1040
? A. sp. 1470
Dentalina sp. 510
Eoguttulina sp. 1030
Eponides sp. 220
Globulina sp. 510
Guttulina sp. 510
Haplophragmoides sp. 510
H. sp. 1040
Lagena sp. 735
Marginulinopsis sp. 1030
Paleopolymorphina sp. 510
Proteonina sp. 1300
Reophax sp. 980
Saracenaria sp. 1300
? Textularia sp. 510
Verneuilina sp. 1040
V. sp. 1190

Correlation of the Mount Goodenough Section

Marine equivalents of the Lower Cretaceous rocks of Mount Goodenough are unknown in western Canada. Therefore, correlation is made with microfossil zones set up in northwestern Germany by Hecht (1938). Comparison between German and Mount Goodenough Foraminifera reveals many related species and suggests a late Barremian and Aptian age for the sampled portion of the Mount Goodenough section (i.e. the upper shale-siltstone division of Jeletzky). The following paired species show marked similarity:

Mount Goodenough

Ammodiscus sp. 1210

Dentalina sp. 510

D. sp. 1420

Epistomina sp. 1590

Eponides sp. 220

Globigerina sp. 1040

Glomospira sp. 1240

Guttulina sp. 510

Lagena sp. 1420

Marginulina sp. 1400

Marginulinopsis sp. 1030

Nodosaria sp. 1590

Robulus sp. 1490

R. sp. 1590

Tritaxia sp. 1300

Verneuilina sp. 1190

Germany (Hecht, 1938)

Ammodiscus sp. D-2

Dentalina sp. D-11

D. sp. D-12

Epistomina sp. D-7

Eponides sp. D-1

Globigerina sp. D-9

Glomospira sp. D-2

Guttulina sp. D-13

Lagena sp. D-9

Cristellaria sp. D-82

Marginulina sp. D-13

Nodosaria sp. D-60

Cristellaria sp. D-78

C. sp. D-67

Tritaxia sp. D-4

Verneuilina sp. D-4

This interregional correlation was facilitated by similar species of Globigerina in both areas. Although the appearance of analogous planktonic Foraminifera in widely spaced localities is not enough evidence by itself to prove the existence of zonal correlation, it does, however, strongly suggest approximate time equivalence. Jeletzky (1958, p. 12), for example, has found such Upper Barremian species as Crioceras (Hoplocrioceras) sp., cf. C. remondi (Gabb), Ancyloceras (Acroceras) sp., aff. A. starrkingi Anderson and Ancyloceras (Ancyloceras) durrelli Anderson in a zone which is indicated as being Lower Aptian by microfaunal evidence.

This might be interpreted in two ways: either the microfossil zones on Mount Goodenough are slightly older than the corresponding zones in northwestern Germany, or the macrofossils found by Jeletzky persisted until Lower Albian time.

Many Mount Goodenough Foraminifera compare favorably with Cretaceous Foraminifera from Texas and Peace River, Alberta. Similarity to Peace River species might indicate an ancestral relationship ^{and} ~~that~~ would suggest the persistence of boreal types in this area until Albian and Cenomanian time. Resemblance to Texas Foraminifera is difficult to explain in view of our present knowledge of Cretaceous paleogeology.

PALEOECOLOGY

The paleoecology of the Mount Goodenough Foraminifera is contrasted with that of Foramnifera studied by Tappan (1960) from the Cretaceous of the Alaskan Arctic slope. Because the ^C~~A~~rtic slope flooding during Cretaceous time probably extended into the Mount Goodenough area, a brief summary is given below of Tappan's results.

The Cretaceous of northern Alaska consists of an intertonguing marine and non-marine sequence of strata which resulted from strong fluctuations in sea level. Microfaunal facies seem to follow these fluctuations across time lines, so that instead of setting up time-parallel zones, Tappan has divided her facies into a littoral environment, an inner sublittoral environment, an outer sublittoral environment, and an open sea environment.

The littoral facies contains a faunal assemblage of arenaceous Foraminifera that are commonly small and stunted. Locally these may be abundant in number of specimens, but never in number of species.

Unstable shore line conditions during most of Cretaceous time have produced an offshore facies indicative of high turbidity and turbulence. The inner sublittoral facies is characterized by arenaceous Foraminifera which include representatives of families Rhizamminidae, Reophacidae, Ammodiscidae, Lituolidae, Textulariidae, Verneuilinidae and Valvulinidae. This faunal assemblage is similar to the littoral facies, except that there

is a slight increase in the number of species present, and most specimens tend to be large and robust rather than stunted because of high turbidity and turbulence. Calcareous Foraminifera are rare or absent and they usually occur as pyritic casts indicative of rapid deposition.

The outer sublittoral facies was less affected by turbidity and turbulence during Cretaceous time. This is reflected by an increase in faunal variety and by the occurrence of calcareous and arenaceous Foraminifera in about equal numbers. Calcareous Foraminifera are represented by Lagenidae, Buliminidae and Rotaliidae which occur as siliceous tests rather than pyritic casts.

The open sea facies is characterized by a mixed calcareous and arenaceous assemblage of Foraminifera. Although planktonic species may commonly be present in this facies, they do not necessarily indicate deep water conditions. All that can be concluded is that ocean currents and not offshore currents have been the dominant factor in controlling the faunal assemblage.

By assuming analogous conditions between northern Yukon and northern Alaska, it is possible to assess the zones as collected on Mount Goodenough. The Epistomina sp. 1590, Haplophragmoides sp. 1490, and Discorbis sp. 1470 zones probably represent an environment midway between an inner sublittoral and outer sublittoral. Although these assemblages are predominantly of arenaceous Foraminifera such as Reophax, Ammobaculites, Haplophragmoides, Verneuilina and Hyperammina, there is a relatively large number of calcareous species. This would indicate that

turbidity conditions and rate of deposition were such as to not greatly inhibit the development of calcareous types. The occurrence of glauconite and non-pyritized calcareous tests in these zones seems to preclude rapid deposition. Robust specimens, however, such as Saracenaria sp. 1590 and Vaginulina sp. 1500 show that turbidity and turbulence might at times have been important.

Toward the top of the Discorbis sp. 1470 zone specimens become rare to absent indicating a possible increase in turbidity. This is substantiated by the faunal assemblage in the overlying Tritaxia sp. 1300 zone which seems to represent a littoral environment of deposition. Except for very rare occurrences of Discorbis sp. 1300 and Pseudoglandulina sp. 1300, this zone consists entirely of arenaceous Foraminifera that are relatively small and stunted.

The upper half of the Tritaxia sp. 1300 zone is relatively barren which probably means a continuation of high turbidity and turbulence. Sometime during this interval, however, conditions began to change, for species of Globigerina begin to appear at the base of the Globigerina sp. 1040 zone. This is indicative of an open sea environment which, as mentioned above, does not necessarily indicate a marked increase in ocean depth, but does suggest that ocean currents were bringing in pelagic specimens.

Planktonic Foraminifera disappear at the base of the Haplophragmoides sp. 510 zone suggesting either an end to open sea conditions or a shift in contributing currents. The Haplophragmoides sp. 510 zone is characterized

by alternating barren and fossiliferous intervals which seem to indicate a continuous change from a littoral to an inner sublittoral environment. Most of the Foraminifera in the fossiliferous bands are robust, coarsely arenaceous species such as Ammobaculites sp. 735, Reophax sp. 980 and ? Textularia sp. 510. A few calcareous specimens also occur, but in any one interval the number of species is never great.

The section on Mount Goodenough sampled for microfauna (i.e. upper shale-siltstone division) represents part of a marine transgression which was apparently confined to a long, narrow embayment extending east from the Bell-Porcupine area, through the Aklavik area, parallel with the Arctic coast to Darnley Bay, and south to lower Peel River. This embayment was probably a structural trough open to the sea on the northwest and surrounded by land on the north, south and east (Jeletzky, 1958, p. 16).

From the evidence given above it would seem that the Mount Goodenough section was probably located in the northern half of this embayment, relatively close to the sea outlet. During middle Barremian time the area was characterized by an inner sublittoral to an outer sublittoral environment. At the close of this stage the sea became shallower and perhaps slightly brackish, and littoral conditions became dominant. This type of environment lasted until early Aptian time when the sea apparently deepened allowing oceanic currents to re-enter the embayment. During late Aptian time conditions fluctuated between a littoral and an inner sublittoral type of environment (Fig. 3).

CYCLES OF ENVIRONMENT
INDICATED BY THE
MOUNT GOODENOUGH MICROFAUNA

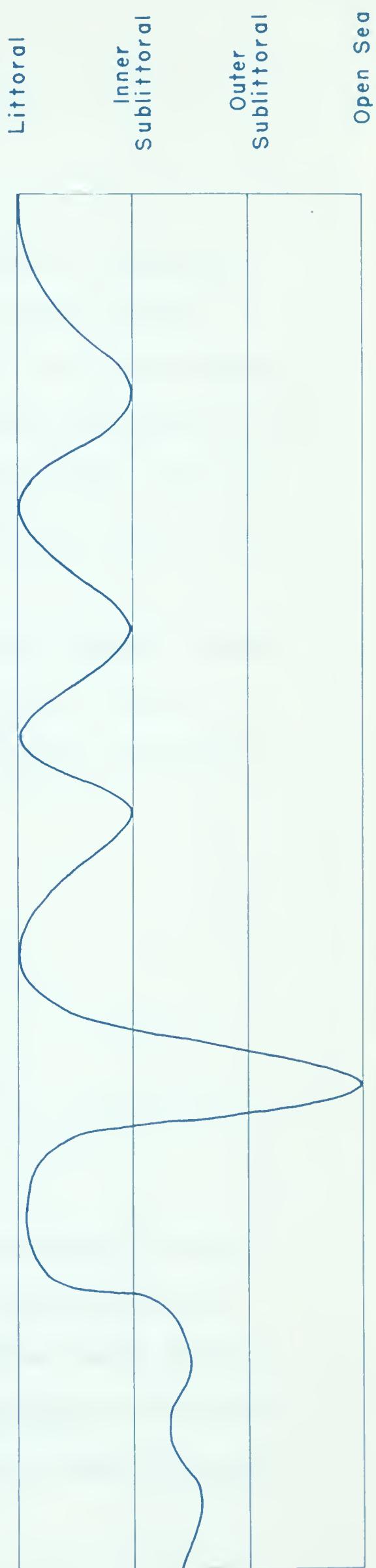
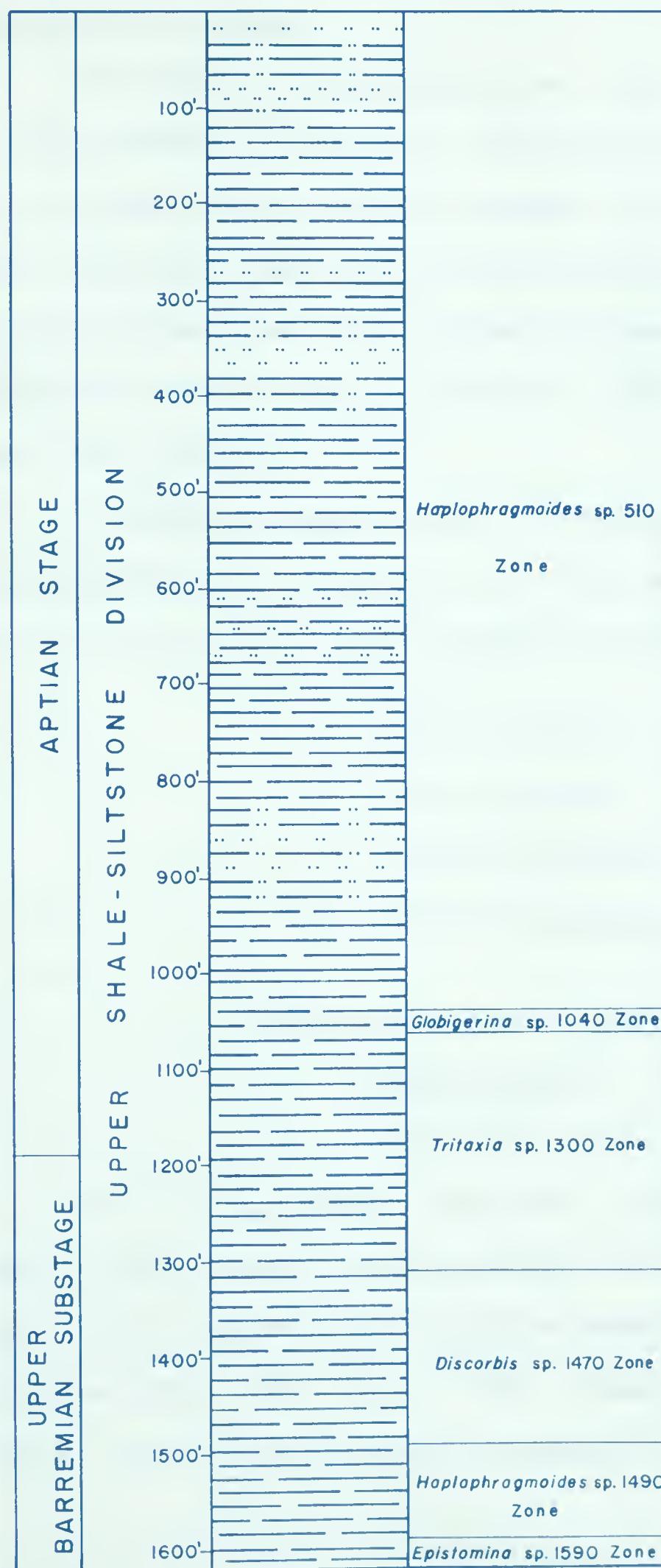


Figure 3

FORMAL DESCRIPTIONS OF MICROFAUNA

Introductory Statement

The Mount Goodenough microfaunal suite contains 30 calcareous and 26 arenaceous Foraminifera. Although there are quantitatively more calcareous than arenaceous species, the latter are much more abundant. Major comparisons are made with the Foraminifera described by Hecht (1938) from the Barremian and Aptian stages of northwestern Germany. Additional reference is made to similar species from the Cretaceous of Texas, and Peace River, Alberta.

Foraminifera are described in alphabetical and numerical sequence. All species numbers correspond to the interval in which a specimen occurs below the top of the stratigraphic section on Mount Goodenough.

Phylum PROTOZOA

Class SARCODINA

Subclass RHIZOPODA

Order FORAMINIFERA

Genus AMMOBACULITES Cushman, 1910

Ammobaculites sp. 735

Plate III, figure 9

Test large, elongate, compressed, slightly pyritized; earlier stage of four chambers, closely coiled, involute, planispiral; later stage of three chambers, uniserially arranged; chambers fairly distinct, increasing gradually in size as added; sutures depressed in later portion, oblique, curved; wall arenaceous, composed of coarse to fine silt grains

in much translucent cement, surface rather rough, ornamented by very faint longitudinal costae; aperture at terminal end of uncoiled portion, obscured by rough surface; color light brown.¹

Length of figured specimen: 0.76 mm.; diameter of coiled portion 0.20 mm.; length of ultimate chamber 0.26 mm.

Locality and horizon of figured specimen: From 735 to 740 feet below top of Mount Goodenough section, Aklavik Range, Northwest Territories, Canada; Aptian stage, Haplophragmoides sp. 510 zone.

Figured specimen: University of Alberta paleontological type collection; description based on figured specimen No. 125-1.

Remarks: This species is common and is restricted to the Haplophragmoides sp. 510 zone.

Ammobaculites sp. 1030, cf. A. torosus

Loeblich and Tappan

Plate III, figure 5

Test medium, compressed; earlier stage composed of three chambers, closely coiled, involute, planispiral; later stage composed of four chambers, uniserially arranged; chambers distinct, increasing gradually in size as added, slightly inflated, especially last formed chamber; sutures distinct, moderately depressed, straight, those of earlier stage radiate, later ones transverse to long axis; wall finely arenaceous,

¹ Specimen colors are taken from the Rock-Color Chart (Rock-Color Chart Committee, 1951).

rather smoothly finished, with much cement; aperture terminal, central, at end of small collar; color light brown.

Length of figured specimen: 0.64 mm.; diameter of coiled portion 0.24 mm.; length of ultimate chamber 0.22 mm.

Locality and horizon of figured specimen: From 1,030 to 1,040 feet below top of Mount Goodenough section, Aklavik Range, Northwest Territories, Canada; Aptian stage, Haplophragmoides sp. 510 zone.

Figured specimen: University of Alberta paleontological type collection; description based on figured specimen No. 125-2.

Comparison: This species is similar to Ammobaculites torosus Loeblich and Tappan from the Lower Cretaceous Fredericksburg group of Texas, but has a slightly smaller collar.

Remarks: Ammobaculites sp. 1030 is rare and appears to be restricted to both the Haplophragmoides sp. 510 zone and Globigerina sp. 1040 zone.

Ammobaculites sp. 1040

Plate III, figure 6

Test medium, elongate, pyritized; earlier portion of four chambers, closely coiled, planispiral; later portion of four chambers, arranged in an irregular uniserial pattern; chambers very distinct, subcircular in transverse section, somewhat inflated, ultimate one slightly produced; sutures distinct, depressed, straight, radiate in coiled portion, slightly oblique in later portion; wall arenaceous, rather rough, composed of coarse to medium silt grains in much cement; aperture circular, terminal, central.

Length of figured specimen: 0.70 mm.; diameter of coiled portion 0.15 mm.; length of ultimate chamber 0.31 mm.

Locality and horizon of figured specimen: From 1,030 to 1,040 feet below top of Mount Goodenough section, Aklavik Range, Northwest Territories, Canada; Aptian stage, Haplophragmoides sp. 510 zone.

Figured specimen: University of Alberta paleontological type collection; description based on figured specimen No. 125-3.

Comparison: This species resembles Ammobaculites fragmentarius Cushman from the Lower Cretaceous Joli Fou formation of Athabasca River, Alberta, but differs in being more slender and having a slightly produced ultimate chamber.

Remarks: Although rare, Ammobaculites sp. 1040 occurs in all Barremian and Aptian zones of the Mount Goodenough section.

Ammobaculites sp. 1300

Plate II, figure 10

Test medium, elongate; earlier portion composed of three chambers, closely coiled, involute, planispiral; later portion composed of four chambers, uniserially arranged; chambers distinct, inflated, roughly equal in size in earlier stage, increasing rapidly in diameter in later stage as added; sutures fairly distinct, slightly depressed, oblique in later portion; wall arenaceous, composed of fine to coarse silt grains buried in much cement, surface rather smooth; aperture simple, terminal, on slight projection of ultimate chamber; color pale yellowish orange.

Length of figured specimen: 0.65 mm.; diameter of coiled portion 0.15 mm.; length of ultimate chamber 0.21 mm.

Locality and horizon of figured specimen: From 1,300 to 1,310 feet below top of Mount Goodenough section, Aklavik Range, Northwest Territories, Canada; Barremian stage, Tritaxia sp. 1300 zone.

Figured specimen: University of Alberta paleontological type collections, description based on figured specimen No. 125-4.

Remarks: This species is common and it seems to be restricted to the Tritaxia sp. 1300 zone.

? Ammobaculites sp. 1470

Plate II, figure 3

Test large, slightly pyritized, somewhat compressed; earlier stage indistinct, later stage uncoiled, uniserially arranged, slightly inflated; sutures rather indistinct, oblique to long axis, straight, depressed; wall arenaceous, composed of subangular, very fine sand to coarse silt grains, in thick coating of translucent cement, surface rough with many projecting grains that obscure chambers and sutures; aperture terminal, central; color pale brown.

Length of figured specimen: 0.90 mm.; maximum breadth 0.31 mm.

Locality and horizon of figured specimen: From 1,470 to 1,480 feet below top of Mount Goodenough section, Aklavik Range, Northwest Territories, Canada; Barremian stage, Discorbis sp. 1470 zone.

Figured specimen: University of Alberta paleontological type collection; description based on figured specimen No. 125-5.

Remarks: The generic assignment of this specimen is in doubt. The relatively large size of the initial stage suggests that it is probably a group of coiled chambers. If, however, it is a single chamber, it would

be either a megalospheric stage of Ammobaculites, or belong to the genus Reophax Montfort, 1808.

This species occurs commonly in all Barremian and Aptian zones of the Mount Goodenough section.

Genus AMMOBACULOIDES Plummer, 1932

? Ammobaculoides sp. 1300

Plate II, figure 16

Test small, elongate, pyritized, slightly compressed, earlier portion of three chambers, apparently closely coiled, planispiral; later portion of three chambers, arranged in an irregular uniserial pattern; chambers distinct, depressed, oblique; wall arenaceous, composed of fine silt in much cement; aperture terminal, central.

Length of figured specimen: 0.42 mm.; length of ultimate chamber 0.14 mm.

Locality and horizon of figured specimen: From 1,300 to 1,310 feet below top of Mount Goodenough section, Aklavik Range, Northwest Territories, Canada; Barremian stage, Tritaxia sp. 1300 zone.

Figured specimen: University of Alberta paleontological type collection; description based on figured specimen No. 125-6.

Remarks: The generic assignment of this species is in question because the arrangement of the initial three chambers is not understood. Instead of being coiled they might be interpreted as biserial, in which case the specimen would belong to Textularia Defrance. The present classification was chosen because of the similarity between the Mount Goodenough specimen and Ammobaculoides navarroensis Plummer from the

Upper Cretaceous Navarro group of Texas.

? Ammobaculoides sp. 1300 occurs commonly and it is restricted to the Tritaxia sp. 1300 zone.

Genus AMMODISCUS Reuss, 1861

Ammodiscus sp. 1210, cf. Ammodiscus sp. D-2 Hecht

Plate II, figure 22

Test small, planispiral, involute, pyritized, much compressed, slightly concave on both sides; chamber tubular, increasing gradually and uniformly in size; wall finely arenaceous, thin, rather smooth; aperture semicircular, at end of tubular chamber; color light brown.

Maximum diameter of figured specimen: 0.23 mm.; minimum diameter 0.20 mm.

Locality and horizon of figured specimen: From 1,210 to 1,220 feet below top of Mount Goodenough section, Aklavik Range, Northwest Territories, Canada; Barremian stage, Tritaxia sp. 1300 zone.

Figured specimen: University of Alberta paleontological type collection; description based on figured specimen No. 125-7.

Comparison: This species is similar to Ammodiscus sp. D-2 Hecht from the Barremian, Aptian and Lower Albian stages of Germany, but differs by being slightly smaller.

Remarks: Ammodiscus sp. 1210 occurs very rarely and it is restricted to the Tritaxia sp. 1300 zone.

Genus BULIMINA d'Orbigny, 1826

? Bulimina sp. 1510

Plate I, figure 14

Test small, triserial, tapering rapidly, initial end bluntly pointed, transverse section almost circular, greatest breadth near apertural end; chambers indistinct, increasing very rapidly in size as added, last formed somewhat inflated; sutures indistinct, slightly depressed, gently curved; wall calcareous, smooth, very finely perforate; aperture loop-shaped, at inner margin of last formed chamber; color moderate orange-pink.

Length of figured specimen: 0.30 mm.; maximum breadth 0.19 mm.

Locality and horizon of figured specimen: From 1,510 to 1,520 feet below top of Mount Goodenough section, Aklavik Range, Northwest Territories, Canada; Barremian stage, Haplophragmoides sp. 1490 zone.

Figured specimen: University of Alberta paleontological type collection; description based on figured specimen No. 125-8.

Remarks: Poor preservation has obscured the arrangement of the earlier chambers making identification of this specimen difficult. Its loop-shaped aperture seems to be the best evidence for placing it into this genus.

? Bulimina sp. 1510 occurs very rarely and it seems to be restricted to the Haplophragmoides sp. 1490 zone.

Genus DENTALINA d'Orbigny, 1826

Dentalina sp. 510

Plate III, figure 16

Test small, elongate, slightly compressed, of two chambers arranged

in uniserial pattern, initial end broadly rounded; chambers distinct, subglobular, of uniform shape; suture distinct, diagonal, slightly curved, depressed; wall calcareous, very smooth, finely perforate, hyaline; aperture radiate, on a slight terminal projection.

Length of figured specimen: 0.46 mm.; maximum breadth 0.23 mm.; greatest thickness 0.18 mm.

Locality and horizon of figured specimen: From 510 to 520 feet below top of Mount Goodenough section, Aklavik Range, Northwest Territories, Canada; Aptian stage, Haplophragmoides sp. 510 zone.

Figured specimen: University of Alberta paleontological type collection; description based on figured specimen No. 125-9.

Comparison: This specimen is similar to Dentalina sp. D-11 Hecht from the Aptian of Germany, except that it is smaller and has fewer chambers. The Mount Goodenough specimen might be a juvenile stage which would account for this apparent difference.

Remarks: Dentalina sp. 510 occurs very rarely and it appears to be restricted to the Haplophragmoides sp. 510 zone.

Dentalina sp. 1420

Plate II, figure 13

Test large, elongate, of four chambers arranged in uniserial pattern, somewhat arcuate; chambers distinct, slightly inflated, ovoid in transverse section; sutures moderately depressed, distinct, oblique, straight; wall calcareous, thick, finely perforate, smooth, translucent, unornamented; aperture at outer margin, on end of small neck, radiate; color white.

Length of figured specimen: 0.93 mm.; maximum breadth 0.30 mm.

Locality and horizon of figured specimen: From 1,420 to 1,430 feet below top of Mount Goodenough section, Aklavik Range, Northwest Territories, Canada; Barremian stage, Discorbis sp. 1470 zone.

Figured specimen: University of Alberta paleontological type collection; description based on figured specimen No. 125-10.

Comparison: Although this specimen has been badly flattened and deformed, it resembles Dentalina sp. D-12 Hecht from the Hauterivian and Barremian stages of Germany, except that its chambers are less inflated.

Remarks: Dentalina sp. 1420 occurs very rarely and it is restricted to the Discorbis sp. 1470 zone.

Dentalina sp. 1490

Plate I, figure 12

Test medium, elongate, of two chambers arranged uniserially, initial end broadly rounded; chambers very distinct, globose, of similar size and shape; suture distinct, broadly depressed, nearly perpendicular to long axis, straight; wall calcareous, thick, coarsely perforate, aperture terminal, nearly central, at end of short conical neck, radiate, with six prominent slits; color white.

Length of figured specimen: 0.67 mm.; maximum diameter 0.34 mm.

Locality and horizon of figured specimen: From 1,490 to 1,500 feet below top of Mount Goodenough section, Aklavik Range, Northwest Territories, Canada; Barremian stage, Haplophragmoides sp. 1490 zone.

Figured specimen: University of Alberta paleontological type collection; description based on figured specimen No. 125-11.

Comparison: This specimen resembles Dentalina catenula Reuss from the Upper Cretaceous Taylor group of Texas, except that it is shorter and does not have a small projection on the initial end. The relatively large size and few chambers of the Mount Goodenough species suggest that it is a megalospheric form and thus might explain its shortness.

Remarks: Dentalina sp. 1490 occurs rarely and it seems to be restricted to the Haplophragmoides sp. 1490 zone.

Dentalina sp. 1570

Plate I, figure 7

Test medium, sturdy, elongate, of two chambers with suggestion of a small proloculus at base of penultimate chamber, uniserially arranged; chambers distinct, about equal in size, slightly inflated, subcircular in transverse section; sutures distinct, moderately depressed, perpendicular to long axis, straight; wall calcareous, finely perforate, translucent, very faintly costate, moderately thick; aperture terminal, nearly central, radiate, color greyish yellow.

Length of figured specimen: 0.69 mm.; maximum diameter 0.22 mm.

Locality and horizon of figured specimen: From 1,570 to 1,580 feet below top of Mount Goodenough section, Aklavik Range, Northwest Territories, Canada; Barremian stage, Haplophragmoides sp. 1490 zone.

Figured specimen: University of Alberta paleontological type collection; description based on figured specimen No. 125-12.

Remarks: This species occurs rarely and it is restricted to the Haplophragmoides sp. 1490 zone.

Genus DISCORBIS Lamarck, 1804

Discorbis sp. 1300

Plate II, figure 18

Test very small, trochoid, dextral, of two whorls, pyritized, concavo-convex; ventral side slightly concave, umbilicate; periphery rounded; chambers distinct, somewhat inflated, nine visible on ventral side, thirteen visible on spiral side; sutures distinct, slightly depressed, radiate, gently curved; wall calcareous, smooth rather thin, aperture ventral, at inner margin of last formed chamber.

Maximum diameter of figured specimen: 0.18 mm.; minimum diameter 0.15 mm.; greatest thickness 0.06 mm.

Locality and horizon of figured specimen: From 1,300 to 1,310 feet below top of Mount Goodenough section, Aklavik Range, Northwest Territories, Canada; Barremian stage, Tritaxia sp. 1300 zone.

Figured specimen: University of Alberta paleontological type collection; description based on figured specimen No. 125-13.

Remarks: This species occurs very rarely and appears to be confined to the Tritaxia sp. 1300 zone.

Discorbis sp. 1470

Plate II, figure 2

Test small, trochoid, dextral, concavo-convex, of two whorls; ventral side moderately concave, moderately umbilicate; periphery acute, lobate; chambers distinct, compressed, seven visible on ventral side, thirteen visible on spiral side; sutures distinct, radiate, strongly curved, slightly depressed; wall calcareous, thin, coarsely perforate;

aperture on umbilical side at inner margin of ultimate chamber, with slightly overhanging lip; color moderate orange-pink.

Maximum diameter of figured specimen: 0.26 mm.; minimum diameter 0.18 mm.; greatest thickness 0.09 mm.

Locality and horizon of figured specimen: From 1,470 to 1,480 feet below top of Mount Goodenough section, Aklavik Range, Northwest Territories, Canada; Barremian stage, Discorbis sp. 1470 zone.

Figured specimen: University of Alberta paleontological type collection; description based on figured specimen No. 125-14.

Comparison: This species is similar to Discorbis minima Vieaux from the Lower Cretaceous Washita group of Texas, but differs by being slightly more concave on the ventral side.

Remarks: Because Discorbis sp. 1470 is common and is restricted to a stratigraphic interval of 180 feet, it was chosen as a zone fossil.

Genus DOROTHIA Plummer, 1931

Dorothia sp. 1300

Plate II, figure 8

Test small, elongate, rather gently tapering, pyritized; early portion of two or three whorls, with four or five chambers in a whorl, later portion triserial, finishing twisted biserial; chambers rather indistinct in earlier stage, becoming distinct in later stage, increase gradually in size toward apertural end; sutures distinct, moderately depressed, slightly oblique, straight; wall rather smooth, composed of fine silt buried in moderate cement; aperture a high arch at inner margin of terminal face.

Length of figured specimen: 0.35 mm.; maximum breadth 0.12 mm.

Locality and horizon of figured specimen: From 1,300 to 1,310 feet below top of Mount Goodenough section, Aklavik Range, Northwest Territories, Canada; Barremian stage, Tritaxia sp. 1300 zone.

Figured specimen: University of Alberta paleontological type collection; description based on figured specimen No. 125-15.

Comparison: This species closely resembles Dorothia kaskapauensis var. gracilis Stelck and Wall from Upper Cenomanian Kaskapau formation of Spirit River, Alberta, but differs by having one less whorl in the earlier stage of development.

Remarks: Dorothia sp. 1300 occurs commonly in both the Tritaxia sp. 1300 zone and Discorbis sp. 1470 zone.

Genus EGGERELLA Cushman, 1933

Eggerella sp. 1570

Plate I, figure 10

Test medium, elongate, pyritized; earlier portion of two to three whorls, with four or five chambers in a whorl; later portion of seven whorls, triserially arranged; chambers of earlier stage indistinct, making up about one-sixth of test; later chambers slightly inflated, increasing regularly in size toward aperture; earlier sutures indistinct, later ones distinct, slightly depressed, form a zig-zag pattern between chambers; wall arenaceous, even, composed of very fine silt grains in much cement; aperture an arch at base of last formed chamber.

Length of figured specimen: 0.61 mm.; maximum breadth 0.20 mm.

Locality and horizon of figured specimen: From 1,570 to 1,580 feet below top of Mount Goodenough section, Aklavik Range, Northwest Territories, Canada; Barremian stage, Haplophragmoides sp. 1490 zone.

Figured specimen: University of Alberta paleontological type collection; description based on figured specimen No. 125-16.

Remarks: This species occurs commonly in both the Discorbis sp. 1470 zone and Haplophragmoides sp. 1490 zone.

Genus EOGUTTULINA Cushman and Ozawa, 1930

Eoguttulina sp. 1030

Plate III, figure 7

Test medium, elongate, fusiform; chambers three, distinct, ellipsoidal, arranged in a spiral series, each succeeding chamber removed farther from base; sutures distinct, slightly depressed, somewhat curved; wall calcareous, very smooth, hyaline, very finely perforate; aperture terminal, radiate.

Length of figured specimen: 0.43 mm.; maximum diameter 0.24 mm.

Locality and horizon of figured specimen: From 1,030 to 1,040 feet below top of Mount Goodenough section, Aklavik Range, Northwest Territories, Canada; Aptian stage, Haplophragmoides sp. 510 zone.

Figured specimen: University of Alberta paleontological type collection; description based on figured specimen No. 125-17.

Comparison: This species is similar to Eoguttulina anglica Cushman and Ozawa, 1930, but differs by having broader chambers.

Remarks: Eoguttulina sp. 1030 occurs very rarely in the lower part of the Haplophragmoides sp. 510 zone.

Genus EPISTOMINA Terquem, 1883

Epistomina sp. 1590, cf. Epistomina sp. D-7 Hecht

Plate I, figure 1

Test small, trochoid, dextral, biconvex, ovate, of three whorls, seven chambers in ultimate whorl; ventral side slightly convex; spiral side conical; periphery subrounded; chambers distinct, gradually increasing in size, all visible on spiral side, only those of last whorl visible ventrally; sutures distinct, somewhat thickened, flush, oblique, gently curved; wall calcareous, rather coarsely perforate, thick, generally smooth; aperture on ventral side, at inner margin of last chamber; color light brown.

Maximum diameter of figured specimen: 0.26 mm.; minimum diameter 0.19 mm.; greatest thickness 0.12 mm.

Locality and horizon of figured specimen: From 1,590 to 1,600 feet below top of Mount Goodenough section, Aklavik Range, Northwest Territories, Canada; Barremian stage, Epistomina sp. 1590 zone.

Figured specimen: University of Alberta paleontological type collection; description based on figured specimen No. 125-18.

Comparison: This species closely resembles Epistomina sp. D-7 Hecht from the Barremian of Germany, except that it is slightly more ovate.

Remarks: Because Epistomina sp. 1590 occurs abundantly and is restricted to a stratigraphic interval of 30 feet, it was chosen as a zone fossil.

Genus EPONIDES Montfort, 1808

Eponides sp. 220

Plate III, figure 17

Test small, fragile, trochoid, dextral, biconvex, of two whorls,

containing fourteen chambers; periphery subrounded; chambers distinct, gradually increasing in size, all visible on spiral side, obscured on ventral side by material adhering to test; sutures indistinct in earlier portion, becoming distinct in later portion, oblique on spiral side, slightly curved, flush; wall calcareous, finely perforate, thin; aperture ventral, at inner margin of ultimate chamber; color light brown.

Maximum diameter of figured specimen: 0.20 mm.; greatest thickness 0.07 mm.

Locality and horizon of figured specimen: From 220 to 230 feet below top of Mount Goodenough section, Aklavik Range, Northwest Territories, Canada, Aptian stage, Haplophragmoides sp. 510 zone.

Figured specimen: University of Alberta paleontological type collection; description based on figured specimen No. 125-19.

Comparison: Although this specimen has been slightly flattened, it does bear some similarity to Eponides sp. D-1 Hecht from the Lower Albian of Germany. The Mount Goodenough form appears to have broader chambers in the last whorl, and its sutures are not as curved as Eponides sp. D-1 Hecht.

Remarks: Eponides sp. 220 occurs very rarely in the upper part of the Haplophragmoides sp. 510 zone.

Genus GAUDRYINA d'Orbigny, 1839

Gaudryina sp. 1300

Plate II, figure 11

Test medium, elongate, pyritized, slightly tapering, slender; initial three whorls triserial, ultimate five biserial, somewhat twisted; chambers distinct, of similar size and shape in triserial portion,

slightly inflated in biserial portion, increase regularly in size as added; sutures distinct, depressed, oblique; wall finely arenaceous with moderate cement; aperture a high arch at base of last chamber.

Length of figured specimen: 0.52 mm.; maximum breadth 0.13 mm.

Locality and horizon of figured specimen: From 1,300 to 1,310 feet below top of Mount Goodenough section, Aklavik Range, Northwest Territories, Canada; Barremian stage, Tritaxia sp. 1300 zone.

Figured specimen: University of Alberta paleontological type collection; description based on figured specimen No. 125-20.

Comparison: This species resembles Gaudryina hectori Nauss from the Joli Fou formation of Athabasca River, Alberta, but differs by having less inflated chambers, especially in the biserial portion.

Remarks: Gaudryina sp. 1300 occurs commonly and it is restricted to the Tritaxia sp. 1300 zone.

Genus GLOBIGERINA d'Orbigny, 1826

Globigerina sp. 1040, cf. Globigerina sp. D-9 Hecht

Plate II, figure 24; Plate III, figure 2

Test medium, trochoid, pyritized, biconvex, of two whorls, broadly and deeply umbilicate; periphery rounded, lobate; chambers very distinct, earlier ones slightly flattened, later ones globular, five visible on umbilical side, six to eight visible on spiral side, increase regularly in size as added; sutures very distinct, deeply depressed, radiate, straight; wall calcareous, moderately thick, coarsely perforate; aperture an arch at base of last chamber opening into umbilical area.

Maximum diameter of megalospheric stage: 0.34 mm. (Plate II, figure 24).

Maximum diameter of microspheric stage: 0.35 mm. (Plate III,
figure 2).

Locality and horizon of figured specimen: Microspheric stage
from 1,040 to 1,050 feet and megalospheric stage from 1,050 to 1,060
feet below top of Mount Goodenough section, Aklavik Range, Northwest
Territories, Canada; Aptian stage, Globigerina sp. 1,040 zone.

Figured specimen: University of Alberta paleontological type
collection; description based on microspheric stage, figured specimen
No. 125-21 and megalospheric stage, figured specimen No. 125-22.

Comparison: This species is almost identical to Globigerina sp.
D-9 Hecht from the lowermost Aptian of northwestern Germany, but differs
by being slightly larger.

Remarks: The spiral view (Plate II, figure 24) of the megalospheric
stage of this species clearly shows the relatively large proloculus
and reduced number of chambers.

Because Globigerina sp. 1040 occurs abundantly and is restricted
to a stratigraphic interval of 20 feet, it was chosen as a zone fossil.

Genus GLOBULINA d'Orbigny, 1839

Globulina sp. 510

Plate III, figure 13

Test medium, very slightly compressed, subglobular, of four
chambers; initial end broadly rounded, terminal end slightly produced,
transverse section oval; chambers distinct, extend back toward base,
embracing; sutures distinct, very slightly depressed, gently curved; wall
calcareous, translucent, thin, very finely perforate, smooth; aperture
terminal, radiate; color moderate orange-pink.

Length of figured specimen: 0.48 mm.; breadth 0.35 mm.; maximum thickness 0.29 mm.

Locality and horizon of figured specimen: From 510 to 520 feet below top of Mount Goodenough section, Aklavik Range, Northwest Territories, Canada; Aptian stage, Haplophragmoides sp. 510 zone.

Figured specimen: University of Alberta paleontological type collection; description based on figured specimen No. 125-23.

Comparison: This species is similar to Globulina lacrima canadensis Mellon and Wall from the Middle Albian Moosebar formation of the upper Pine River area, British Columbia. The Mount Goodenough specimen appears more oblate because it does not have a conical neck.

Remarks: Globulina sp. 510 occurs very rarely in the middle of the Haplophragmoides sp. 510 zone.

Genus GLOMOSPIRA Rzehak, 1888

Glomospira sp. 1230

Plate II, figure 20

Test small, composed of a proloculus and a long, undivided, tubular second chamber, loosely coiled in varying planes, suture rather indistinct, slightly depressed; wall arenaceous, composed of fine to medium silt grains in much clear cement; aperture simple; color grayish orange-pink.

Maximum diameter of figured specimen: 0.32 mm.

Locality and horizon of figured specimen: From 1,230 to 1,240 feet below top of Mount Goodenough section, Aklavik Range, Northwest Territories, Canada; Barremian stage, Tritaxia sp. 1300 zone.

Figured specimen: University of Alberta paleontological type collection; description based on figured specimen No. 125-24.

Remarks: This specimen has been somewhat flattened making it appear discoid in shape.

Glomospira sp. 1230 occurs rarely in both the Globigerina sp. 1040 zone and Tritaxia sp. 1300 zone.

Glomospira sp. 1240

Plate II, figure 21

Test medium to large, roughly ellipsoidal, coils tight, occurring in varying, irregular planes, proloculus hidden by long, undivided, second chamber; suture indistinct, depressed; wall arenaceous, consists of coarse to fine silt in much cement; aperture simple; color moderate orange-pink.

Maximum diameter of figured specimen: 0.55 mm.; minimum diameter 0.33 mm.

Locality and horizon of figured specimen: From 1,230 to 1,240 feet below top of Mount Goodenough section, Aklavik Range, Northwest Territories, Canada; Barremian stage, Tritaxia sp. 1300 zone.

Figured specimen: University of Alberta paleontological type collection; description based on figured specimen No. 125-25.

Comparison: This species resembles Glomospira sp. D-2 Hecht from the Barremian, Aptian and Albian of Germany, but differs by being slightly larger and more ellipsoidal.

Remarks: Glomospira sp. 1240 occurs rarely and it is restricted to the Tritaxia sp. 1300 zone.

Glomospira sp. 1530

Plate I, figure 9

Test very large, roughly discoid, composed of a subglobular proloculus and a long, undivided, tubular second chamber; earlier coils planispiral, later ones loosely coiled in varying planes; suture distinct, moderately depressed; wall arenaceous, consists of fine to coarse silt in much cement, surface uneven; aperture simple, subcircular; color very pale orange.

Maximum diameter of figured specimen: 0.84 mm.

Locality and horizon of figured specimen: From 1,530 to 1,540 feet below Mount Goodenough section, Ak lavik Range, Northwest Territories, Canada; Barremian stage, Haplophragmoides sp. 1490 zone.

Figured specimen: University of Alberta paleontological type collection; description based on figured specimen No. 125-26.

Remarks: This species occurs rarely and it is restricted to the Haplophragmoides sp. 1490 zone.

Genus GUTTULINA d'Orbigny, 1839

Guttulina sp. 510

Plate III, figure 14

Test medium, slightly flattened and twisted, ovate, of four chambers, initial end broadly rounded, apertural end moderately produced; chambers distinct, extend back toward base; sutures distinct, slightly depressed, oblique, gently curved; wall calcareous, very finely perforate, smooth, translucent; aperture terminal, radiate; color very pale orange.

Length of figured specimen: 0.62 mm.; breadth 0.33; maximum thickness 0.25 mm.

Locality and horizon of figured specimen: From 510 to 520 feet below top of Mount Goodenough section, Aklavik Range, Northwest Territories, Canada; Aptian stage, Haplophragmoides sp. 510 zone.

Figured specimen: University of Alberta paleontological type collection; description based on figured specimen No. 125-27.

Comparison: This species is similar to Guttulina sp. D-13 Hecht from the Aptian of Germany, except that it is slightly broader and has depressed suture lines.

Remarks: Guttulina sp. 510 occurs very rarely in the middle of the Haplophragmoides sp. 510 zone.

Genus HAPLOPHRAGMOIDES Cushman, 1910

Haplophragmoides sp. 510

Plate III, figure 8

Test large, strongly compressed, slightly pyritized; periphery rounded, umbilical area filled with cement; chambers fairly distinct, seven visible in last whorl, cameral portions depressed in fossilization; sutures distinct, very slightly depressed, radiate, straight; wall arenaceous, thin, composed of fine silt grains in moderate cement; surface uneven; aperture a low arch at base of terminal face; color moderate brown.

Maximum diameter of figured specimen: 0.69 mm.; maximum thickness 0.19 mm.

Locality of figured specimen: From 510 to 520 feet below top of Mount Goodenough section, Aklavik Range, Northwest Territories, Canada; Aptian stage, Haplophragmoides sp. 510 zone.

Figured specimen: University of Alberta paleontological type collection; description based on figured specimen No. 125-28.

Comparison: This species resembles Haplophragmoides excavatus Cushman and Waters from the Upper Cretaceous Navarro and Taylor groups of Texas, but differs by having an acute periphery and fewer chambers visible in the last whorl.

Remarks: Because Haplophragmoides sp. 510 occurs abundantly and is restricted to a stratigraphic interval of 1040 feet, it was chosen as a zone fossil.

Haplophragmoides sp. 1040

Plate III, figure 1

Test large, sturdy, pyritized, slightly compressed, planispiral; periphery broadly rounded; chambers very distinct, six visible in last formed whorl, increase gradually in size as added; sutures distinct, limbate, radiate, slightly curved, wall arenaceous, very thick, composed chiefly of very fine sand to coarse silt grains, securely cemented; aperture a low arch at base of last chamber.

Maximum diameter of figured specimen: 0.64 mm.

Locality and horizon of figured specimen: From 1,040 to 1,050 feet below top of Mount Goodenough section, Aklavik Range, Northwest Territories, Canada; Aptian stage, Globigerina sp. 1040 zone.

Figured specimen: University of Alberta paleontological type collection; description based on figured specimen No. 125-29.

Remarks: This specimen is badly deformed; the axis of coiling is prominently skewed making the test appear asymmetrical.

Haplophragmoides sp. 1040 occurs commonly in all Barremian and Aptian zones of the Mount Goodenough section.

Haplophragmoides sp. 1490, cf. H. globosus Lozo

Plate I, figure 11

Test medium, closely coiled, planispiral, globose, prominently umbilicate; periphery broadly rounded; chambers distinct, wedge-shaped, eight visible in last formed whorl, increase gradually in size as added; sutures distinct, thickened, moderately depressed, radiate, straight; wall finely arenaceous, thick, with much clear cement; aperture a low, rounded arch at base of terminal face; color light brown.

Maximum diameter of figured specimen: 0.51 mm.; maximum thickness 0.39 mm.

Locality and horizon of figured specimen: From 1,490 to 1,500 feet below top of Mount Goodenough section, Aklavik Range, Northwest Territories, Canada; Barremian stage, Haplophragmoides sp. 1490. zone.

Figured specimen: University of Alberta paleontological type collection; description based on figured specimen No. 125-30.

Comparison: This form closely resembles Haplophragmoides globosus Lozo from the Lower Cretaceous Trinity and Fredericksburg groups of Texas, but differs by having more depressed suture lines.

Remarks: Because Haplophragmoides sp. 1490 occurs abundantly and is restricted to a stratigraphic interval of 100 feet, it was chosen as a zone fossil.

Genus HYPERAMMINA H.B. Brady, 1878

Hyperammina sp. 1510

Plate I, figure 8

Test large, elongate, somewhat compressed, consists of a long, undivided tubular chamber with incipient cross breaks; wall arenaceous, composed chiefly of fine to medium silt grains, surface uneven due to much cement; color very pale orange.

Length of figured specimen: 0.83 mm.

Locality and horizon of figured specimen: From 1,510 to 1,520 feet below top of Mount Goodenough section, Aklavik Range, Northwest Territories, Canada; Barremian stage, Haplophragmoides sp. 1490 zone.

Figured specimen: University of Alberta paleontological type collection; description based on figured specimen No. 125-31.

Remarks: This specimen is fragmentary; both proloculus and aperture are missing.

Hyperammina sp. 1510 occurs commonly and it is restricted to the Haplophragmoides sp. 1490 zone.

Genus LAGENA Walker and Jacob, 1798

Lagena sp. 735

Plate III, figure 12

Test medium, globular, consists of a single chamber; wall calcareous, smooth, finely perforate, translucent, thin; aperture terminal, incipiently radiate, at end of a stubby neck; color moderate orange-pink.

Length of figured specimen: 0.44 mm.; diameter 0.34 mm.

Locality and horizon of figured specimen: From 735 to 750 feet below top of Mount Goodenough section, Aklavik Range, Northwest Territories, Canada; Aptian stage, Haplophragmoides sp. 510 zone.

Figured specimen: University of Alberta paleontological type collection; description based on figured specimen No. 125-32.

Comparison: This specimen is similar to Lagena sp., cf. L. globosa (Montague) of the Upper Cretaceous Taylor and Navarro groups of Texas, but differs by having a slightly shorter and more stubby neck.

Remarks: Lagena sp. 735 occurs commonly and it appears to be restricted to the Haplophragmoides sp. 510 zone.

Lagena sp. 1420

Plate II, figure 12

Test medium, globular, consists of a single chamber, initial end broadly rounded with a small projection; wall calcareous, thin, finely perforate, smooth; aperture terminal, incipiently radiate, at end of prominent neck; color very pale orange.

Length of figured specimen: 0.46 mm.; diameter 0.33 mm.

Locality and horizon of figured specimen: From 1,420 to 1,430 feet below top of Mount Goodenough section, Aklavik Range, Northwest Territories, Canada; Barremian stage, Discorbis sp. 1470 zone.

Figured specimen: University of Alberta paleontological type collection; description based on figured specimen No. 125-33.

Comparison: Although the small projection at the base of the test has been partially broken, this species resembles Lagena sp. D-9 Hecht from the Barremian of Germany, except that it has a more prominent neck.

Remarks: This species occurs commonly in both the Discorbis sp. 1470 zone and Haplophragmoides sp. 1490 zone of the Barremian stage.

Genus MARGINULINA d'Orbigny, 1826

Marginulina sp. 1400

Plate II, figure 6

Test small, inflated; earlier stage coiled, later stage becoming uncoiled; terminal face strongly convex, subcircular in transverse section; chambers fairly distinct, initial five increase uniformly in size as added, ultimate one strongly inflated, embracing, reaching back to cover earlier chambers; sutures rather indistinct, flush in early stages, slightly depressed in last stage; wall calcareous, rather thick, perforate; aperture radiate, on small protrusion at outer margin of last formed chamber; color moderate orange-pink.

Length of figured specimen: 0.37 mm.; breadth 0.26 mm.

Locality and horizon of figured specimen: From 1,400 to 1,410 feet below top of Mount Goodenough section, Aklavik Range, Northwest Territories, Canada; Barremian stage, Discorbis sp. 1470 zone.

Figured specimen: University of Alberta paleontological type collection; description based on figured specimen No. 125-34.

Comparison: This species resembles Cristellaria sp. D-82 Hecht from the Barremian of Germany, but differs by having a more produced aperture and a slightly more inflated last chamber.

Remarks: Marginulina sp. 1400 occurs rarely and it seems to be restricted to the Discorbis sp. 1470 zone, Haplophragmoides sp. 1490 zone, and Epistomina sp. 1590 zone.

Marginulina sp. 1590

Plate I, figure 3

Test medium, elongate, slightly compressed; periphery acute with a small keel that is confined to the earlier chambers; dorsal margin convex, ventral margin concave; chambers distinct, initial four or five sharply coiled, ultimate four uncoiled, increasing gradually in size as added; sutures distinct, raised, somewhat granulate, curved; wall calcareous, finely perforate, ornamented by eight or nine longitudinal costae that extend from coiled portion to adult chambers; aperture radiate, on a small projecting cone at outer margin of last formed chamber; color very pale orange.

Length of figured specimen: 0.62 mm.; breadth 0.30 mm.; maximum thickness 0.20 mm.

Locality and horizon of figured specimen: From 1,590 to 1,600 feet below top of Mount Goodenough section, Aklavik Range, Northwest Territories, Canada; Barremian stage, Epistomina sp. 1590 zone.

Figured specimen: University of Alberta paleontological type collection; description based on figured specimen No. 125-35.

Comparison: This species resembles Marginulinopsis collinsi Mellon and Wall from the Middle Albian Clearwater formation of Athabasca River, Alberta, but has fewer costae, a better developed coiled stage, and is slightly longer.

Remarks: Marginulina sp. 1590 occurs rarely in both the Haplophragmoides sp. 1490 zone and Epistomina sp. 1590 zone.

Genus MARGINULINOPSIS Silvestri, 1904

Marginulinopsis sp. 1030

Plate III, figure 4

Test medium to small, elongate, arcuate; earlier portion almost completely coiled, later portion uncoiled, oval in transverse section; chambers distinct, first seven increase regularly in size as added, ultimate one slightly inflated, produced; sutures distinct, flush, gently curved; wall calcareous, ornamented with about nine prominent costae parallel to periphery and terminating at base of last chamber; aperture radiate, on a small projection at the outer margin of last formed chamber; color light brown.

Length of figured specimen: 0.43 mm.; breadth 0.19 mm.; maximum thickness 0.14 mm.

Locality and horizon of figured specimen: From 1,030 to 1,040 feet below top of Mount Goodenough section, Aklavik Range, Northwest Territories, Canada; Aptian stage, Haplophragmoides sp. 510 zone.

Figured specimen: University of Alberta paleontological type collection; description based on figured specimen No. 125-36.

Comparison: This specimen is similar to Marginulina sp. D-13 Hecht from the Neocomian, Aptian and Albian of Germany, but differs by having costae that terminate near the base of the last formed chamber.

Remarks: Marginulinopsis sp. 1030 occurs commonly at the base of the Haplophragmoides sp. 510 zone.

Genus MILIAMMINA Heron-Allen and Earland, 1930

Miliammina sp. 1590

Plate I, figure 6

Test small, pyritized, ellipsoidal; chambers distinct, tubular,

in quinqueloculine arrangement, each a half coil in length, three visible on one side, four on the other; sutures distinct, depressed; wall very finely arenaceous with much cement, smooth; aperture a simple, round opening with small tooth, at end of a short neck.

Length of figured specimen: 0.36 mm.; breadth 0.25 mm.; maximum thickness 0.17 mm.

Locality and Horizon of figured specimen: From 1,590 to 1,600 below top of Mount Goodenough section, Aklavik Range, Northwest Territories, Canada; Barremian stage, Epistomina sp. 1590 zone.

Figured specimen: University of Alberta paleontological type collection; description based on figured specimen No. 125-37.

Comparison: This species resembles Miliammina sproulei Nauss from the Middle Albian Joli Fou formation of Athabasca River, Alberta, but differs by not being strongly compressed and having slightly shorter chambers.

Remarks: Miliammina sp. 1590 occurs very rarely and it is restricted to the Epistomina sp. 1590 zone.

Genus NODOSARIA Lamarck, 1812

Nodosaria sp. 1490

Plate I, figure 15

Test small, fragmentary, elongate, of two chambers in a straight, linear series, tapering; chambers distinct, inflated, subcircular in transverse section, not strongly embracing; suture distinct, moderately depressed, perpendicular to long axis, straight; wall calcareous, ornamented by longitudinal costae that extend full length of test, finely perforate; aperture unknown, probably terminal; color very pale orange.

Length of figured specimen: 0.43 mm.; diameter 0.21 mm.

Locality and horizon of figured specimen: From 1,490 to 1,500 feet below top of Mount Goodenough section, Aklavik Range, Northwest Territories, Canada; Barremian stage, Haplophragmoides sp. 1490 zone.

Figured specimen: University of Alberta paleontological type collection; description based on figured specimen No. 125-38.

Remarks: This specimen has been badly broken making it difficult to find an accurate comparison.

Nodosaria sp. 1490 occurs rarely in both the Discorbis sp. 1470 zone and Haplophragmoides sp. 1490 zone.

Nodosaria sp. 1590

Plate I, figure 4

Test very large, fragmentary, of three chambers arranged uniserially, tapering, initial end bluntly pointed; chambers distinct, subglobular; sutures distinct, broadly depressed, slightly oblique, thickened; wall calcareous, thick, smooth, very finely perforate; aperture unknown; color very pale orange.

Length of figured specimen: 0.98 mm.; diameter 0.27 mm.

Locality and horizon of figured specimen: From 1,590 to 1,600 feet below top of Mount Goodenough section, Aklavik Range, Northwest Territories, Canada; Barremian stage, Epistomina sp. 1590 zone.

Figured specimen: University of Alberta paleontological type collection; description based on figured specimen No. 125-39.

Comparison: Although the aperture is not present on this specimen, it resembles Nodosaria sp., cf. N. sp. D-60 Hecht from the Barremian of Germany. The Mount Goodenough form differs by being larger and having

suture lines that are less depressed.

Remarks: Nodosaria sp. 1590 occurs rarely and it is restricted to the Epistomina sp. 1590 zone.

Genus PALEOPOLYMORPHINA Cushman and Ozawa, 1930

Paleopolymorphina sp. 510

Plate III, figure 11

Test large, elongate, compressed, slightly arcuate, of six, embracing, somewhat inflated chambers; sutures distinct, oblique, gently curved; wall calcareous, transparent, smooth, very finely perforate; aperture terminal, radiate, at end of very small neck; color pale yellowish orange.

Length of figured specimen: 0.96 mm.; breadth 0.35 mm.; maximum thickness 0.21 mm.

Locality and horizon of figured specimen: From 510 to 520 below top of Mount Goodenough section, Aklavik Range, Northwest Territories, Canada; Aptian stage, Haplophragmoides sp. 510 zone.

Figured specimen: University of Alberta paleontological type collection; description based on figured specimen No. 125-40.

Remarks: This species occurs rarely and appears to be restricted to the Haplophragmoides sp. 510 zone.

Genus PROTEONINA Williamson, 1858

Proteonina sp. 1300

Plate II, figure 14

Test small, consists of a single, flask-shaped, undivided chamber with a distinct, tubular, slightly tapering neck; wall arenaceous,

composed of fine to medium sand grains in much cement, surface rather rough; aperture terminal, simple; color light brown.

Length of figured specimen: 0.29 mm.; breadth 0.20 mm.

Locality and horizon of figured specimen: From 1,300 to 1,310 feet below top of Mount Goodenough section, Aklavik Range, Northwest Territories, Canada; Barremian stage, Tritaxia sp. 1300 zone.

Figured specimen: University of Alberta paleontological type collection; description based on figured specimen No. 125-41.

Comparison: This specimen resembles Proteonina difflugiformis (Brady) from the Upper Cretaceous Navarro group of Texas, except that it has a much larger neck.

Remarks: Proteonina sp. 1300 occurs rarely in the Haplophragmoides sp. 510 zone, Globigerina sp. 1040 zone and Tritaxia sp. 1300 zone.

Proteonina sp. 1400

Plate II, figure 7

Test medium, elongate, consists of a flask-shaped undivided chamber with a thick, tubular neck tapering gradually from main part of chamber; wall arenaceous, thick, composed chiefly of coarse silt to fine sand grains in much cement, surface very uneven; aperture terminal, simple; color light brown.

Length of figured specimen: 0.58 mm.; breadth 0.28 mm.

Locality and horizon of figured specimen: From 1,400 to 1,410 feet below top of Mount Goodenough, Aklavik Range, Northwest Territories, Canada; Barremian stage, Discorbis sp. 1470 zone.

Figured specimen: University of Alberta paleontological type collection; description based on figured specimen No. 125-42.

Remarks: This species occurs rarely and it seems to be confined to the Discorbis sp. 1470 zone and Haplophragmoides sp. 1490 zone.

Genus PSEUDOGLANDULINA Cushman, 1929

Pseudoglandulina sp. 1300

Plate II, figure 17

Test small, somewhat fusiform, pyritized, consists of four chambers uniserially arranged; chambers distinct, circular in transverse section, embracing, increase regularly in breadth as added, last formed inflated and produced; sutures distinct, depressed, perpendicular to long axis, straight; wall calcareous, finely perforate, rather smooth; aperture simple, at end of long, slender neck.

Length of figured specimen: 0.38 mm.; diameter 0.15 mm.

Locality and horizon of figured specimen: From 1,300 to 1,310 feet below top of Mount Goodenough section, Aklavik Range, Northwest Territories, Canada; Barremian stage, Tritaxia sp. 1300 zone.

Figured specimen: University of Alberta paleontological type collection; description based on figured specimen No. 125-43.

Remarks: This species occurs rarely and it is restricted to the Tritaxia sp. 1300 zone.

Genus REOPHAX Montfort, 1808

Reophax sp. 980

Plate III, figure 10

Test medium, elongate, slightly compressed, consists of three chambers in a straight, uniserial series, chambers distinct, undivided; sutures indistinct, slightly depressed, straight; wall arenaceous,

composed of medium to coarse, subangular silt grains in much cement, surface very rough; aperture terminal, obscure; color light brown.

Length of figured specimen: 0.62 mm.; breadth 0.25 mm.

Locality and horizon of figured specimen: From 980 to 1,000 feet below top of Mount Goodenough section, Aklavik Range, Northwest Territories, Canada; Aptian stage, Haplophragmoides sp. 510 zone.

Figured specimen: University of Alberta paleontological type collection; description based on figured specimen No. 125-44.

Remarks: This species occurs commonly in all Barremian and Aptian zones of the Mount Goodenough section.

Genus ROBULUS Montfort, 1808

Robulus sp. 1490, cf. Cristellaria sp. D-78 Hecht

Plate I, figure 13

Test large, planispiral, involute, slightly umbonate, compressed; periphery subacute with a broad, thin keel; chambers very distinct, ten visible in adult whorl, increasing gradually in size as added; sutures distinct, thickened, slightly raised, gently curved; wall calcareous, finely perforate, smooth; aperture at peripheral angle, radiate; color white.

Maximum diameter of figured specimen: 0.65 mm.; maximum thickness 0.35 mm.

Locality and horizon of figured specimen: From 1490 to 1,500 feet below top of Mount Goodenough section, Aklavik Range, Northwest Territories, Canada; Barremian stage, Haplophragmoides sp. 1490 zone.

Figured specimen: University of Alberta paleontological type collection; description based on figured specimen No. 125-45.

Comparison: This species closely resembles Cristellaria sp. D-78 Hecht from the Barremian, Aptian, and Albian of Germany, except that it has a broader keel and is more disk-shaped.

Remarks: Robulus sp. 1490 occurs commonly in the Discorbis sp. 1470 zone, Haplophragmoides sp. 1490 zone and Epistomina sp. 1590.

Genus ROBULUS Montfort, 1808

Robulus sp. 1590, cf. Cristellaria sp. D-67 Hecht

Plate I, figure 2

Test medium, planispiral, involute, slightly umbonate, moderately compressed; periphery subacute with a low, narrow keel that largely disappears in later portion; chambers distinct, seven visible in adult whorl, last formed markedly produced; sutures distinct, somewhat thickened, flush, gently curved; wall calcareous, finely perforate, smooth; aperture radiate, on a prominent projection at peripheral angle; color white.

Maximum diameter of figured specimen: 0.47 mm.; maximum thickness 0.19 mm.

Locality and horizon of figured specimen: From 1,590 to 1,600 feet below top of Mount Goodenough section, Aklavik Range, Northwest Territories, Canada; Barremian stage, Epistomina sp. 1590 zone.

Figured specimen: University of Alberta paleontological type collection; description based on figured specimen No. 125-46.

Comparison: This species is very similar to Cristellaria sp. D-67 figured by Hecht from the Barremian of Germany, except that it has a less prominent umbilical plug.

Remarks: Robulus sp. 1590 occurs rarely and it seems to be

restricted to the Haplophragmoides sp. 1490 zone and Epistomina sp. 1590 zone.

Genus SACCAMMINA M. Sars, 1869

Saccammina sp. 1300

Plate II, figure 19

Test medium, flattened, consists of a single, undivided chamber, slightly pyritized; wall arenaceous, composed of subangular, coarse to medium silt grains in moderate cement; aperture terminal, obscure; color light brown.

Length of figured specimen: 0.53 mm.; breadth 0.42 mm.

Locality and horizon of figured specimen: From 1,300 to 1,310 feet below top of Mount Goodenough section, Aklavik Range, Northwest Territories, Canada; Barremian stage, Tritaxia sp. 1300 zone.

Figured specimen: University of Alberta paleontological type collection; description based on figured specimen No. 125-47.

Remarks: This form has been badly flattened making the test appear tabular in shape.

Saccammina sp. 1300 occurs commonly and it is restricted to the Tritaxia sp. 1300 zone.

Genus SARACENARIA Defrance, 1824

Saracenaria sp. 1300

Plate II, figure 9

Test small, earlier portion rather broadly coiled, adult portion uncoiled, triangular in transverse section; periphery subacute, terminal face somewhat flattened; chambers five in coiled stage, two in uncoiled stage, wedge-shaped, increase uniformly in size as added; sutures distinct,

thick, flush, rather strongly curved; wall calcareous, coarsely perforate, moderately thick; aperture terminal, radiate; color very pale orange.

Length of figured specimen: 0.33 mm.; breadth 0.23 mm.; maximum thickness 0.15 mm.

Location and horizon of figured specimen: From 1,300 to 1,310 feet below top of Mount Goodenough section, Aklavik Range, Northwest Territories, Canada; Barremian stage, Tritaxia sp. 1300 zone.

Figured specimen: University of Alberta paleontological type collection; description based on figured specimen No. 125-48.

Comparison: This species is similar to Saracenaria projectura Stelck and Wall from the Middle Albian Clearwater formation of Athabasca River, Alberta, but differs by having thicker sutures and a more broadly coiled initial stage.

Remarks: Saracenaria sp. 1300 occurs rarely at the base of the Haplophragmoides sp. 510 zone and in the Tritaxia sp. 1300 zone.

Saracenaria sp. 1400

Plate II, figure 5

Test medium, elongate, compressed; earlier portion somewhat coiled, adult portion uncoiled, triangular in transverse section; periphery rounded, terminal face distinctly flattened; chambers slightly inflated, six visible, increase regularly in size as added; sutures distinct, slightly depressed, slanting down toward earlier chambers, gently curved; well calcareous, finely perforate, smooth, unornamented; aperture terminal, central, on small projecting cone, radiate; color moderate orange-pink.

Length of figured specimen: 0.53 mm.; breadth 0.29 mm.; maximum width 0.24 mm.

Locality and horizon of figured specimen: From 1,400 to 1,410 feet below top of Mount Goodenough section, Aklavik Range, Northwest Territories, Canada; Barremian stage Discorbis sp. 1470 zone.

Figured specimen: University of Alberta paleontological type collection; description based on figured specimen No. 125-49.

Remarks: This species occurs rarely and it is restricted to Discorbis sp. 1470 zone.

Saracenaria sp. 1470

Plate II, figure 1

Test small, stocky, dorsal margin strongly convex, ventral margin slightly concave; earlier stage close coiled, later stage becoming uncoiled; periphery acute, terminal face broadly flattened; chambers distinct, six visible, increase uniformly in size as added; sutures distinct, flush, gently curved, radiate; wall calcareous, rather thin, finely perforate, ornamented by nine or ten, prominent, longitudinal costae; aperture terminal, at peripheral angle, circular; color moderate orange-pink.

Length of figured specimen: 0.27 mm.; breadth 0.18 mm.; maximum thickness 0.17 mm.

Locality and horizon of figured specimen: From 1,470 to 1,480 below top of Mount Goodenough section, Aklavik Range, Northwest Territories, Canada; Barremian stage, Discorbis sp. 1470 zone.

Figured specimen: University of Alberta paleontological type collection; description based on figured specimen No. 125-50.

Remarks: This species occurs rarely and it is confined to the Discorbis sp. 1470 zone and Haplophragmoides sp. 1490 zone.

Saracenaria sp. 1590

Plate I, figure 5

Test small, sturdy, dorsal margin strongly convex; periphery subrounded, terminal face flattened, sagittal; chambers rather indistinct, initial three closely coiled, ultimate three uncoiled and reaching back to touch proloculus, increase uniformly in size as added; sutures arcuate, flush; wall calcareous, smooth, finely perforate, thick; aperture terminal, at peripheral angle, radiate; color very pale orange.

Length of figured specimen: 0.41 mm.; breadth 0.28 mm.; maximum thickness of apertural face 0.30 mm.

Locality and horizon of figured specimen: From 1,590 to 1,600 feet below top of Mount Goodenough section, Aklavik Range, Northwest Territories, Canada; Barremian stage, Epistomina sp. 1590 zone.

Figured specimen: University of Alberta paleontological type collection; description based on figured specimen No. 125-51.

Remarks: This species occurs rarely and it seems to be restricted to the Epistomina sp. 1590 zone.

Genus TEXTULARIA Defrance, 1824

? Textularia sp. 510

Plate III, figure 15

Test medium, elongate, compressed, appears biserial throughout; chambers very indistinct, only last three clearly visible, somewhat inflated; sutures indistinct, slightly depressed, accentuated in later stage by faint ridges above suture lines; wall arenaceous, composed of medium silt grains in much cement, surface rather rough; aperture terminal, obscure; color light brown.

Length of figured specimen: 0.64 mm.; breadth 0.46 mm.; maximum thickness 0.16 mm.

Locality and horizon of figured specimen: From 510 to 520 feet below top of Mount Goodenough section, Aklavik Range, Northwest Territories, Canada; Aptian stage, Haplophragmoides sp. 510 zone.

Figured specimen: University of Alberta paleontological type collection; description based on figured specimen No. 125-52.

Remarks: The generic position is in doubt. Poor preservation has obscured the earlier chambers and sutures making it very difficult to determine their exact position and arrangement. The arenaceous test and apparently biserial chambers provide the best evidence for placing it into this genus.

? Textularia sp. 510 occurs very rarely and it is restricted to the Haplophragmoides sp. 510 zone.

Genus TRITAXIA Reuss, 1860

Tritaxia sp. 1300

Plate II, figure 15

Test small, elongate, pyritized, triserial throughout, tapering, triangular in transverse section; sides concave, angles rounded; chambers fairly distinct, nine or ten visible, of uniform shape, increasing regularly in size as added, last formed inflated, slightly covering penultimate chamber; sutures distinct, slightly depressed, somewhat oblique; wall finely arenaceous, rather smooth, with moderate cement; aperture terminal, round, at end of short neck.

Length of figured specimen: 0.36 mm.; maximum width 0.19 mm.

Locality and horizon of figured specimen: From 1,300 to 1,310 feet below top of Mount Goodenough section, Aklavik Range, Northwest Territories, Canada; Barremian stage, Tritaxia sp. 1300 zone.

Figured specimen: University of Alberta paleontological type collection; description based on figured specimen No. 125-53.

Comparison: This species resembles Tritaxia sp. D-4 Hecht from the Aptian of Germany, except that it has a more prominent ultimate chamber and apertural neck.

Remarks: Because Tritaxia sp. 1300 occurs commonly and is restricted to a stratigraphic interval of 250 feet, it was chosen as a zone fossil.

Genus VAGINULINA d'Orbigny, 1826

Vaginulina sp. 1490

Plate I, figure 16

Test small, broad, strongly compressed, margins convex, chambers distinct, eight visible, increase in length regularly as added; sutures distinct, slightly depressed, curved; wall calcareous, translucent, finely perforate, ornamented by fine striations giving a hachured effect to chambers; aperture terminal, at peripheral angle, radiate; color very pale orange.

Length of figured specimen: 0.40 mm.; maximum breadth 0.27 mm.

Locality and horizon of figured specimen: From 1,490 to 1,500 feet below top of Mount Goodenough section, Aklavik Range, Northwest Territories, Canada; Barremian stage, Haplophragmoides sp. 1490 zone.

Figured specimen: University of Alberta paleontological type collection; description based on figured specimen No. 125-54.

Remarks: The initial chambers have been broken off the figured specimen.

Vaginulina sp. 1490 occurs very rarely and it seems to be confined to the Haplophragmoides sp. 1490 zone.

Vaginulina sp. 1500

Plate II, figure 4

Test large, slightly compressed; peripheral margin convex, terminal face somewhat flattened; chambers and sutures obscured; wall calcareous, very thick, ornamented by twelve to thirteen coarse, irregular, longitudinal costae that sometimes bifurcate; surface rough, covered by fine sand grains adhering to matrix; aperture unknown; color light to moderate brown.

Length of figured specimen: 0.78 mm.; maximum thickness 0.36 mm.

Locality and horizon of figured specimen: From 1,490 to 1,500 feet below top of Mount Goodenough section, Aklavik Range, Northwest Territories, Canada; Barremian stage, Haplophragmoides sp. 1490 zone.

Figured specimen: University of Alberta paleontological type collection; description based on figured specimen No. 125-55.

Remarks: The apertural end of this specimen has been broken.

Vaginulina sp. 1500 occurs rarely and it is restricted to the Haplophragmoides sp. 1490 zone.

Genus VERNEUILINA d'Orbigny, 1840

Verneuilina sp. 1040

Plate III, figure 3

Test medium, elongate, tapering, pyritized, slightly twisted,

triserial throughout, composed of about eight convolutions; transverse section triangular with rounded angles, initial end acute; chambers distinct, increase regularly in size as added, last three inflated; sutures fairly distinct, slightly depressed, straight; wall arenaceous, composed of medium to fine silt grains in moderate cement, surface slightly uneven; aperture arched, at base of inner margin of last chamber.

Length of figured specimen: 0.53 mm.; maximum width 0.25 mm.

Locality and horizon of figured specimen: From 1,040 to 1,050 feet below top of Mount Goodenough section, Aklavik Range, Northwest Territories, Canada; Aptian stage, Globigerina sp. 1040 zone.

Figured specimen: University of Alberta paleontological type collection; description based on figured specimen No. 125-56.

Remarks: This species occurs commonly in all Barremian and Aptian zones of the Mount Goodenough section.

Verneuilina sp. 1190

Plate II, figure 23

Test small, elongate, pyritized, triserial throughout, composed of seven or eight convolutions, transverse section triangular with broadly rounded angles; chambers distinct, slightly inflated, rather uniform in shape, increase uniformly in size as added, each vertical series with a deep depression between; sutures distinct, slightly thickened, depressed; wall finely arenaceous, rather smooth, moderate cement; aperture arched, at base of inner margin of last formed chamber.

Length of figured specimen: 0.35 mm.; maximum width 0.15 mm.

Locality and horizon of figured specimen: From 1,190 to 1,200 feet below top of Mount Goodenough section, Aklavik Range, Northwest Territories, Canada; Barremian stage, Tritaxia sp. 1300 zone.

Figured specimen: University of Alberta paleontological type collection; description based on figured specimen No. 125-57.

Comparison: This form is similar to Verneuilina sp. D-4 Hecht of the Barremian of Germany, but differs by tapering less abruptly, and by being shorter.

Remarks: This species occurs commonly in all Barremian and Aptian zones of the Mount Goodenough section.

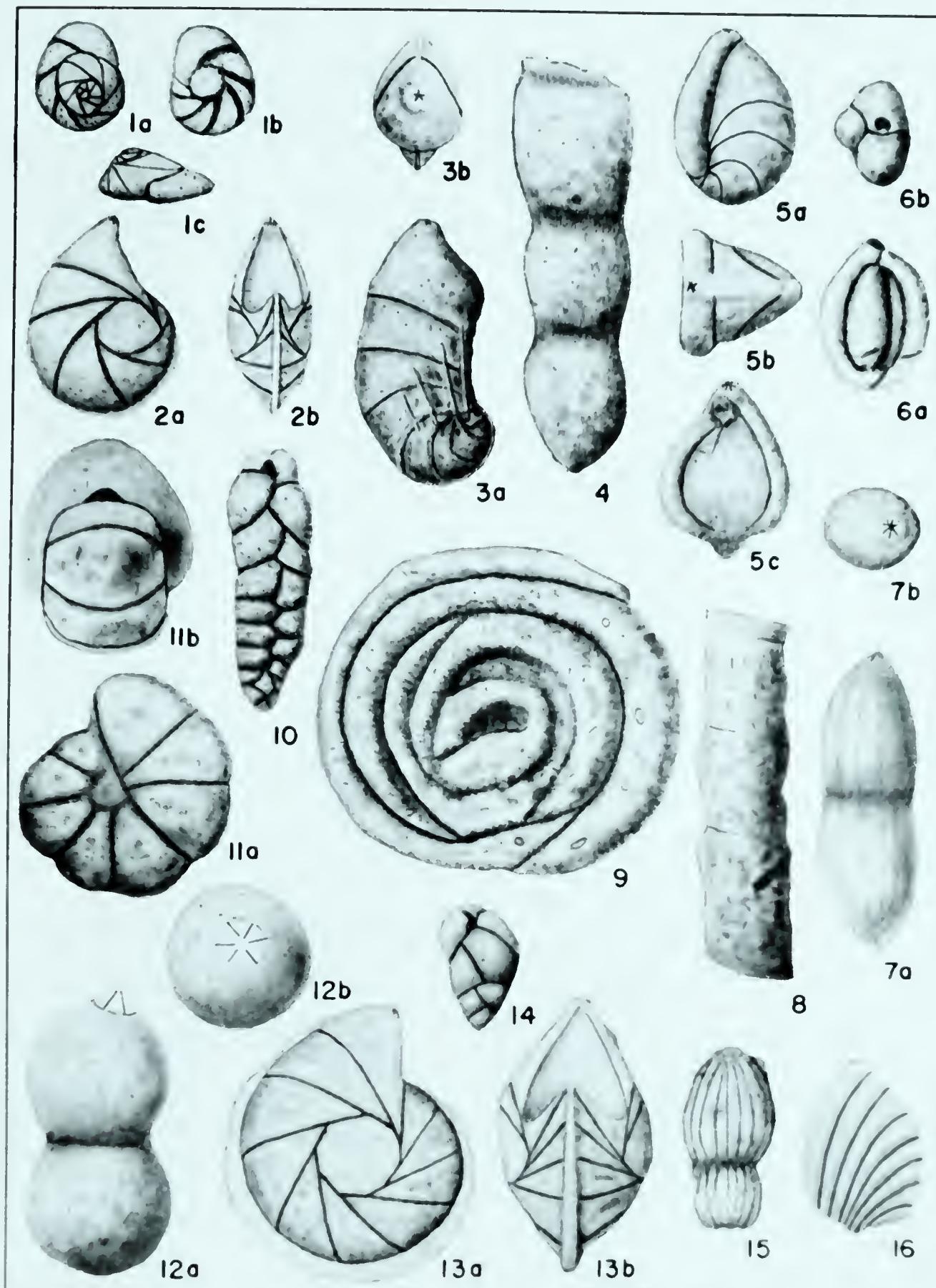
EXPLANATION OF PLATE I

Mount Goodenough Foraminifera
Aklavik Range, Northwest Territories
Magnification approximately x60

- Fig. 1: Epistomina sp. 1590, cf. Epistomina sp. D-7 Hecht;
a-dorsal view, b-ventral view, c-peripheral view p. 32
- Fig. 2: Robulus sp. 1590, cf. Cristellaria sp. D-67 Hecht;
a-side view, b-peripheral view p. 53
- Fig. 3: Marginulina sp. 1590; a-side view, b-apertural view ... p. 45
- Fig. 4: Nodosaria sp. 1590; side view p. 48
- Fig. 5: Saracenaria sp. 1590; a-side view, b-apertural view,
c-front view p. 57
- Fig. 6: Miliammina sp. 1590; a-side view, b-apertural view p. 46
- Fig. 7: Dentalina sp. 1570; a-side view, b-apertural view p. 27
- Fig. 8: Hyperammina sp. 1510; side view p. 42
- Fig. 9: Glomospira sp. 1530; side view p. 38
- Fig. 10: Eggerella sp. 1570; side view p. 30
- Fig. 11: Haplophragmoides sp. 1490, cf. H. globosus Lozo;
a-side view, b-peripheral view p. 41
- Fig. 12: Dentalina sp. 1490; a-side view, b-apertural view p. 26
- Fig. 13: Robulus sp. 1490, cf. Cristellaria sp. D-78 Hecht;
a-side view, b-peripheral view p. 52
- Fig. 14: ? Bulimina sp. 1510; side view p. 24
- Fig. 15: Nodosaria sp. 1490; side view p. 47
- Fig. 16: Vaginulina sp. 1490; side view p. 59

All specimen occur near the base of the Mount Goodenough section
and are Barremian in age.

Plate 1



MOUNT GOODENOUGH FORAMINIFERA

EXPLANATION OF PLATE II

Mount Goodenough Foraminifera
Aklavik Range, Northwest Territories
Magnification approximately x60

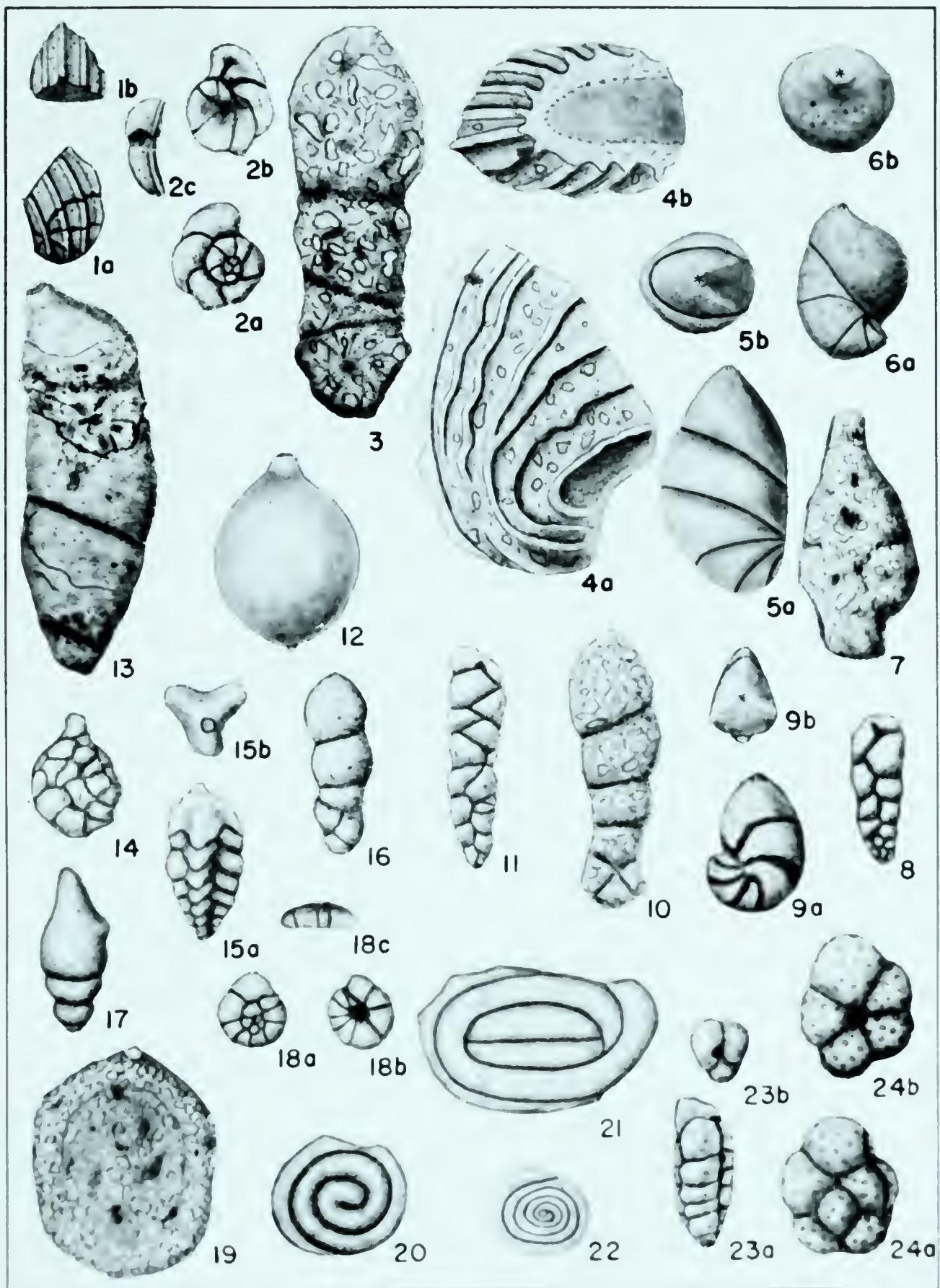
- Fig. 1: Saracenaria sp. 1470; a-side view, b-apertural view p. 56
- Fig. 2: Discorbis sp. 1470; a-dorsal view, b-ventral view,
c-peripheral view p. 28
- Fig. 3: ? Ammobaculites sp. 1470; side view p. 21
- Fig. 4: Vaginulina sp. 1500; a-side view, b-apertural view p. 60
- Fig. 5: Saracenaria sp. 1400; a-side view, b-apertural view ... p. 55
- Fig. 6: Marginulina sp. 1400; a-side view, b-apertural view p. 44
- Fig. 7: Proteonina sp. 1400; side view p. 50
- Fig. 8: Dorothia sp. 1300; side view p. 29
- Fig. 9: Saracenaria sp. 1300; a-side view, b-apertural view p. 54
- Fig. 10: Ammobaculites sp. 1300; side view p. 20
- Fig. 11: Gaudryina sp. 1300; side view p. 33
- Fig. 12: Lagena sp. 1420; side view p. 43
- Fig. 13: Dentalina sp. 1420; side view p. 25
- Fig. 14: Proteonina sp. 1300; side view p. 49
- Fig. 15: Tritaxia sp. 1300; a-side view, b-apertural view p. 58
- Fig. 16: ? Ammobaculoides sp. 1300; side view p. 22
- Fig. 17: Pseudoglandulina sp. 1300; side view p. 51
- Fig. 18: Discorbis sp. 1300; a-dorsal view, b-ventral view,
c-peripheral view p. 28
- Fig. 19: Saccammina sp. 1300; side view p. 54
- Fig. 20: Glomospira sp. 1230; side view p. 36

EXPLANATION OF PLATE II - page 2

- Fig. 21: Glomospira sp. 1240; side view p. 37
Fig. 22: Ammodiscus sp. 1210, cf. Ammodiscus sp. D-2 Hecht;
side view p. 23
Fig. 23: Verneuilina sp. 1190; a-side view, b-apertural view p. 61
Fig. 24: Globigerina sp. 1040, cf. Globigerina sp. D-9 Hecht;
megalospheric stage; a-dorsal view, b-ventral view .. p. 34

All specimens occur within the lower half of the Mount Goodenough section. Figures 1 through 23 are Barremian, and figure 24 is Aptian in age.

Plate II



MOUNT GOODENOUGH FORAMINIFERA

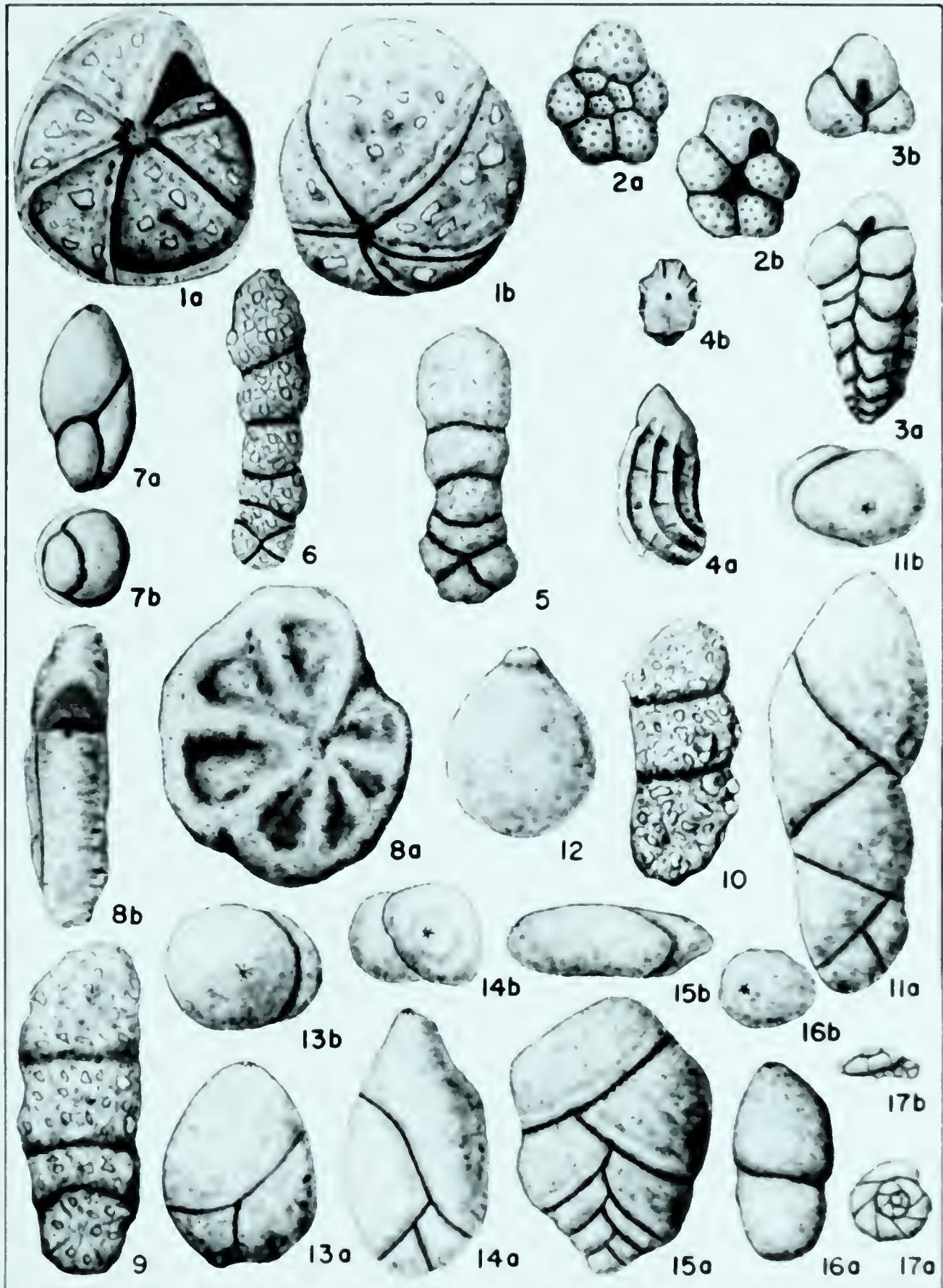
EXPLANATION OF PLATE III

Mount Goodenough Foraminifera
Aklavik Range, Northwest Territories
Magnification approximately x60

- Fig. 1: Haplophragmoides sp. 1040; a,b-views of opposite sides p. 40
- Fig. 2: Globigerina sp. 1040, cf. Globigerina sp. D-9 Hecht, microspheric stage; a-side view, b-apertural view ... p. 34
- Fig. 3: Verneuilina sp. 1040; a-side view, b-apertural view p. 60
- Fig. 4: Marginulinopsis sp. 1030; a-side view, b-apertural view p. 46
- Fig. 5: Ammobaculites sp. 1030, cf. A. torosus Loeblich and Tappan; side view p. 18
- Fig. 6: Ammobaculites sp. 1040; side view p. 19
- Fig. 7: Eoguttulina sp. 1030; a-side view, b-basal view p. 31
- Fig. 8: Haplophragmoides sp. 510; a-side view, b-peripheral view p. 39
- Fig. 9: Ammobaculites sp. 735; side view p. 17
- Fig. 10: Reophax sp. 980; side view p. 51
- Fig. 11: Paleopolymorphina sp. 510; a-side view, b-apertural view p. 49
- Fig. 12: Lagena sp. 735; side view p. 42
- Fig. 13: Globulina sp. 510; a-side view, b-apertural view p. 35
- Fig. 14: Guttulina sp. 510; a-side view, b-apertural view p. 38
- Fig. 15: ? Textularia sp. 510; a-side view, b-apertural view p. 57
- Fig. 16: Dentalina sp. 510; a-side view, b-apertural view p. 24
- Fig. 17: Eponides sp. 220; a-dorsal view, b-peripheral view p. 32

All specimens occur in the upper half of the Mount Goodenough section and are Aptian in age.

Plate III



MOUNT GOODENOUGH FORAMINIFERA

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APPENDIX - PART I

Technical Procedures and Field Work

Shale and siltstone samples from Mount Goodenough were collected from the top, middle and bottom of each ten foot interval measured starting at the top of the section. At every sampling point all weathered material was first removed, then a hole about six inches deep was dug and material ~~taken~~ put into cotton sampling bags. Brief lithological descriptions were made of each ten-foot interval, and this information later compiled and plotted on a standard strip log. A total of forty-seven samples were collected and sent to the University of Alberta for microfaunal study.

Samples were prepared by placing half of each sample into individual pint sealers and soaking in water. After about two weeks when most of the samples were soft enough to disintegrate by hand, they were carefully washed and screened through a nest of Tyler and Endecotts screens. The writer found the following mesh sizes to be the most efficient: 28, 48, 60, 80, 100 and 120.

After screening, the residue in each sieve was transferred to a porcelain dish and dried in an evaporating oven at about 120° C. In order to speed up the picking process, each sieve fraction was run through a Frantz magnetic separator, Model L-1, and the nonmagnetic fraction examined under the microscope.

To avoid the loss of Foraminifera to the magnetic fraction, great care was taken to use the lowest possible amperage, depending upon

the grain size being separated.

Specimens selected for illustration were mounted in single cell slides and drawn using a Spencer camera lucida. Photographs were then taken of these drawings, and the magnification standardized at times 60. Developing and printing was done by the writer using equipment made available by the University of Alberta Geology Department. The individual prints were mounted on white cardboard, retouched where needed, and taken to a commercial firm for rephotographing.

APPENDIX - PART II

Description of outcrop samples from Mount Goodenough, Northwest Territories, Canada. The stratigraphic intervals from 18 to 500 feet and 500 to 1,620 feet correlate approximately with the upper and lower members of Jeletzky's upper shale-siltstone division.

Distance in
feet from
top of
section

Description

18 - 27	<u>Siltstone</u> - pale brown (5YR 5/2) ¹ , well indurated, slightly calcareous, micaceous, some subangular very fine-grained sand; microfauna includes <u>Ammobaculites</u> and <u>Haplophragmoides</u> .
27 - 40	<u>Silty Shale</u> - brownish grey (5YR 4/1), moderately indurated, micaceous.
50 - 60	<u>Silty Shale</u> - brownish grey (5YR 4/1), moderately indurated, arenaceous, abundant carbonaceous fragments; few poorly preserved, arenaceous Foraminifera.
60 - 70	<u>Siltstone</u> - dark yellowish brown (10 YR 4/2), well indurated, slightly arenaceous, much carbonaceous material.
70 - 80	<u>Silty Shale</u> - brownish grey (5YR 4/1), moderately indurated, slightly calcareous, micaceous, abundant carbonaceous fragments; few poorly preserved, arenaceous Foraminifera.
80 - 90	<u>Silty Shale</u> - brownish grey (5YR 4/1), moderately indurated, some carbonaceous material.
90 - 100	<u>Shale</u> - brownish grey (5YR 4/1), moderately indurated, crumbly, some very fine-grained sand and carbonaceous material; few poorly preserved, arenaceous Foraminifera.

¹Colors are taken from the Rock-Color Chart (Rock-Color Chart Committee, 1951).

- 150 - 160 Shale - yellowish brown (10YR 4/2), moderately indurated, micromicaceous, trace glauconite.
- 160 - 180 Shale - dusky yellowish brown (10YR 2/2), well indurated, slightly calcareous, some subangular, very fine grained sand.
- 180 - 190 Shale - brownish black (5YR 2/1), moderately indurated, some carbonaceous material and glauconite.
- 220 - 230 Shale - brownish black (5YR 2/1), moderately indurated, micromicaceous, few carbonaceous fragments; microfauna includes Haplophragmoides and Eponides.
- 240 - 250 Shale - brownish black (5YR 2/1), moderately indurated, only slightly fissile, iron stained, calcareous.
- 250 - 260 Clay-Shale - olive black (5YR 2/1), moderately indurated, micromicaceous, few carbonaceous fragments.
- 260 - 270 Siltstone - brownish black (5YR 2/1), moderately indurated, some subangular, very fine-grained sand and glauconite.
- 280 - 290 Shale - olive black (5YR 2/1), moderately indurated, slightly calcareous, micromicaceous, glauconitic, some carbonaceous material; few poorly preserved arenaceous Foraminifera.
- 500 - 510 Shale - brownish black (5YR 2/1), poorly indurated, crumbly, many carbonaceous fragments.
- 510 - 520 Shale - brownish black (5YR 2/1), moderately indurated, some carbonaceous material, iron stained; microfauna includes Dentalina, Globulina, Guttulina, Haplophragmoides, Ammobaculites, Paleopolymorphina, ? Textularia and Lagena.
- 735 - 750 Shale - brownish black (5YR 2/1), poorly indurated, micromicaceous, crumbly; microfauna includes Ammobaculites, Haplophragmoides, ? Verneuilina, Reophax, Lagena and Proteonina.
- 940 - 960 Shale - brownish black (5YR 2/1), poorly indurated, crumbly, glauconitic, calcareous, abundant, carbonaceous material; few poorly preserved, arenaceous Foraminifera.
- 980 - 1000 Shale - as above; microfauna includes Ammobaculites, Lagena, Haplophragmoides and Reophax.

- 1000 - 1010 Clay-Shale - dark yellowish brown (10YR 4/2), well indurated, flaky, micromicaceous, abundant carbonaceous fragments; microfauna as above.
- 1010 - 1020 Shale - grayish brown (5YR 3/2), poorly indurated, crumbly, much carbonaceous material.
- 1030 - 1040 Shale - brownish black (5YR 2/1), moderately indurated, micromicaceous, calcareous; microfauna includes Ammobaculites, Eoguttulina, Marginulinopsis, Saracenaria and Verneuilina.
- 1040 - 1050 Shale - brownish black (5YR 2/1), moderately indurated, abundant carbonaceous material, trace glauconite; microfauna includes Haplophragmoides, Globigerina, Verneuilina, Ammobaculites, Reophax and Proteonina.
- 1050 - 1060 Shale - as above, but with more glauconite; microfauna as above.
- 1070 - 1080 Clay-Shale - moderate brown (5YR 4/4), very poorly indurated, flaky, calcareous, some carbonaceous material; few poorly preserved arenaceous Foraminifera.
- 1090 - 1100 Clay-Shale - brownish black (5YR 2/1), poorly indurated, flaky, micromicaceous, few carbonaceous fragments.
- 1110 - 1120 Clay-Shale - as above.
- 1130 - 1140 Shale - medium dark grey (N 4), poorly indurated, slightly calcareous, crumbly, iron stained in part; some poorly preserved, arenaceous Foraminifera.
- 1150 - 1160 Shale - as above
- 1170 - 1180 Clay-Shale - brownish grey (5YR 4/1), poorly indurated, flaky, micromicaceous; few poorly preserved, arenaceous Foraminifera.
- 1190 - 1200 Shale - medium dark grey (N 4), moderately indurated, some carbonaceous material; microfauna includes Ammobaculites, Haplophragmoides, Reophax, Tritaxia and Verneuilina.
- 1210 - 1220 Shale - brownish black (5YR 2/1), moderately indurated, glauconitic, micromicaceous, slightly calcareous; microfauna includes Tritaxia, Dorothia and Ammodiscus.
- 1230 - 1240 Shale - as above; microfauna includes Tritaxia, Ammobaculites, Haplophragmoides, Glomospira and Verneuilina.

- 1300 - 1310 Shale - as above; microfauna includes Ammobaculites, Ammodiscus, Tritaxia, Discorbis, Dorothia, Gaudryina, Proteonina, Saccamina, Saracenaria, Haplophragmoides, ? Ammobaculoides and Pseudoglandulina.
- 1330 - 1340 Shale - brownish black (5YR 2/1), moderately indurated, crumbly, micromicaceous.
- 1400 - 1410 Shale - brownish black (5YR 2/1), moderately indurated, glauconitic, some disseminated pyrite, few carbonaceous fragments; microfauna includes Robulus, Discorbis, Ammobaculites, Haplophragmoides, Marginulina, Proteonina, Saracenaria, Eggerella, Dorothia and Nodosaria.
- 1420 - 1430 Shale - as above; microfauna as above, but with Dentalina and Lagena.
- 1440 - 1450 Shale - as above; microfauna includes Robulus, Discorbis, Haplophragmoides, Ammobaculites and Dorothia.
- 1470 - 1480 Shale - as above, but with abundant carbonaceous fragments; microfauna includes Ammobaculites, Discorbis, Saracenaria, Haplophragmoides, Verneuilina, Lagena and Reophax.
- 1490 - 1500 Shale - brownish black (5YR 2/1), poorly indurated, crumbly, glauconitic, micromicaceous, some disseminated pyrite, few carbonaceous fragments; microfauna includes Dentalina, Nodosaria, Robulus, Vaginulina, Lagena, Proteonina, Haplophragmoides, Ammobaculites, Eggerella and Marginulina.
- 1510 - 1520 Shale - as above; microfauna as above, but with ? Bulimina and Hyperammina.
- 1530 - 1540 Shale - as above; microfauna includes Haplophragmoides, Ammobaculites, Glomospira, Saracenaria and Verneuilina.
- 1550 - 1560 Shale - as above, but well indurated, slightly calcareous.
- 1570 - 1580 Shale - brownish black (5YR 2/1), moderately indurated, abundant carbonaceous fragments, trace glauconite; microfauna includes Haplophragmoides, Dentalina, Eggerella, Ammobaculites, ? Bulimina, Reophax, Robulus, and Lagena.

- 1590 - 1600 Shale - brownish black (5YR 2/1), poorly indurated, slightly calcareous, crumbly, glauconitic, some disseminated pyrite, few carbonaceous fragments; microfauna includes Epistomina, Marginulina, Miliammina, Nodosaria, Robulus, Reophax, Saracenaria, Verneuilina, Haplophragmoides and Ammobaculites.
- 1610 - 1620 Shale - as above, but with abundant carbonaceous material; microfauna as above.

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